Issued February 1968

SOIL SURVEY
Blaine County, Oklahoma

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
OKLAHOMA AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this survey was done in the period 1959 to 1962. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1962. This survey was made cooperatively by the Soil Conservation Service and the Oklahoma Agricultural Experiment Station, as part of the technical assistance furnished to the Blaine County Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Blaine County, Okla., contains information that can be applied in managing farms, ranches, and windbreaks and post lots; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

All the soils of Blaine County are shown on the detailed map at the back of this survey. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists all soils of the county in alphabetic order of their map symbols. It shows the page where each kind of soil is described and the page for the capability unit in which the soil has been placed. It also lists the range site and woodland suitability group for each soil.

Individual colored maps showing the relative suitability or limitation of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red or blue.

Farmers and those who work with farmers can learn about use and management of the soils in the soil descriptions and in the discussions of the capability units, range sites, and woodland suitability groups.

Foresters and others can refer to the subsection "Use of Soils for Windbreaks and Post Lots," where the soils are grouped according to their suitability for trees.

Game managers, sportsmen, and others concerned with wildlife will find information about soils and wildlife in the subsection "Wildlife and Fish."

Ranchers and others interested in range can find, under "Use of Soils for Range," groupings of soils according to their suitability for range, and also the plants that grow on each range site.

Engineers and builders will find, under "Engineering Uses of Soils" tables that give estimates of engineering properties of the soils in the county and that name soil features affecting engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Classification and Morphology of Soils."

Students, teachers, and others will find information about soils and their management in various parts of the text.

Newcomers in Blaine County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Facts About the County."

Cover picture.—Beef cattle grazing on Dill fine sandy loam, 1 to 5 percent slopes.

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Contents

NOTICE TO LIBRARIANS

Series year and series number are no longer shown on soil surveys. See explanation on the next page.

Issued February 1968

EXPLANATION

Series Year and Series Number

Series year and number were dropped from all soil surveys sent to the printer after December 31, 1965. Many surveys, however, were then at such advanced stage of printing that it was not feasible to remove series year and number. Consequently, the last issues bearing series year and number will be as follows:

- Series 1957, No. 23, Las Vegas and Eldorado Valleys Area, Nev.
- Series 1958, No. 34, Grand Traverse County, Mich.
- Series 1959, No. 42, Judith Basin Area, Mont.
- Series 1960, No. 31, Elbert County, Colo. (Eastern Part)
- Series 1961, No. 42, Camden County, N.J.
- Series 1962, No. 13, Chicot County, Ark.
- Series 1963, No. 1, Tippah County, Miss.

Series numbers will be consecutive in each series year, up to and including the numbers shown in the foregoing list. The soil survey for Tippah County, Miss., will be the last to have a series year and series number.

SOIL SURVEY OF BLAINE COUNTY, OKLAHOMA

BY CARL F. FISHER, SOIL CONSERVATION SERVICE

SOILS SURVEYED BY CARL F. FISHER, DONALD G. BARTOLINA, AND DUANE L. RIEKE, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE OKLAHOMA AGRICULTURAL EXPERIMENT STATION

BLAINE COUNTY is in the west-central part of Oklahoma. Distances by air from Watonga, the county seat, to principal cities in the State are shown in figure 1. The total land area is 583,040 acres, or 911 square miles.

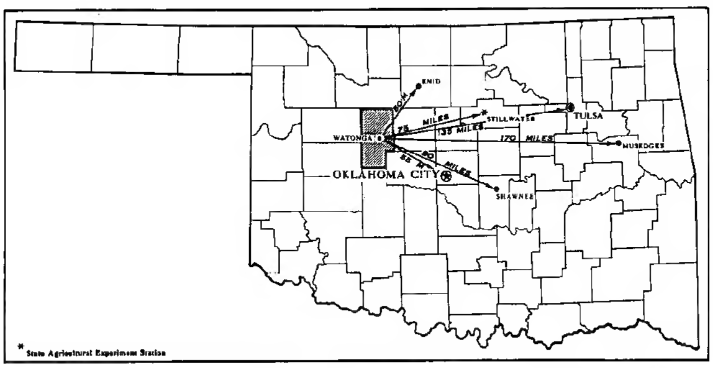

Figure 1.—**Location of Blaine County in Oklahoma.**

Most of Blaine County is covered with loamy soils that are not too sloping for cultivated crops, but there are also large areas of sandy soils that are undulating, rolling, or hummocky. Harvested or forage crops can be grown on all except a small part of the county. The climate is subhumid, but by using dryfarming practices, favorable yields of small grains, especially wheat, and of sorghums, cotton, and alfalfa are obtained. The acreage in crops is decreasing in the county, but the acreage of forage for livestock is increasing. Beef cattle, sheep, and hogs are the main kinds of livestock raised. Dairy cattle are few.

How This Soil Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Blaine County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. For successful use of this survey, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Minco and Shellabarger, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural landscape. Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Minco loam and Minco very fine sandy loam are two soil types in the Minco series. The difference in texture of their surface layers is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Minco loam, 1 to 3 percent slopes, is one of several phases of Minco loam, a soil type that ranges from nearly level to gently sloping.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries

of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that greatly help in drawing soil boundaries accurately. The soil map in the back of this survey was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in size that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it. An example in this soil survey is Carwile-Shellabarger complex, 0 to 2 percent slopes. The soil scientist may also show as one mapping unit two or more soils or land types if the differences between them are so small that they do not justify separation for the purpose of the survey. Such a mapping unit is called an undifferentiated soil group. An example is Vernon soils and Rock outcrop. Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Rough broken land or Sandy broken land, and are called land types rather than soils.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in soil surveys. On the basis of yield and practice tables and other data, the soil scientists set up trial groups, and then test them by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Blaine County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The eight general soil associations of Blaine County are described on the following pages.

1. Norge-Kingfisher-Renfrow Association

Deep, loamy, well-drained, nearly level to sloping soils of the uplands; loamy and clayey subsoil

This association consists of deep, loamy soils of the uplands (fig. 2). Mainly these soils are nearly level to sloping, but in places they are strongly sloping. They occur in one general area in the northeastern part of the county. The total area of this association is 93,000 acres, or about 16 percent of the county.

Norge soils occupy about 35 percent of this association; Kingfisher soils, 20 percent; and Renfrow soils, 20 percent. The rest of the association consists of small areas of Vernon soils, Breaks-Alluvial land complex, and other soils.

The soils of this association are well drained and moderately slowly to very slowly permeable. Their surface soils are neutral to medium acid, and their subsoils and substrata are neutral to calcareous.

The Norge soils have a brown to dark-brown, granular surface layer of loam or fine sandy loam that is 8 to 14 inches thick. The subsoil is alkaline silty clay loam to heavy clay loam that ranges from reddish brown to red in color and from 30 to 50 inches in thickness. The Norge soils formed in loamy and silty, calcareous soil material that is moderately difficult for plant roots to penetrate.

The Renfrow soils have a dark reddish-brown to reddish-brown, granular surface layer of silty clay loam that is 8 to 12 inches thick, except where eroded. The subsoil typically ranges from 30 to 40 inches in thickness. The texture of the subsoil is clayey. The underlying material is fine-textured sediment that formed from shale and clay.

The Kingfisher soils have a reddish-brown, granular surface layer of silt loam that is 10 to 14 inches thick, except where eroded. The subsoil typically ranges from 14 to 25 inches in thickness. The texture of the subsoil ranges from heavy silt loam to silty clay loam. The underlying decomposed silty shale and sandstone is calcareous along the joints and bedding planes.

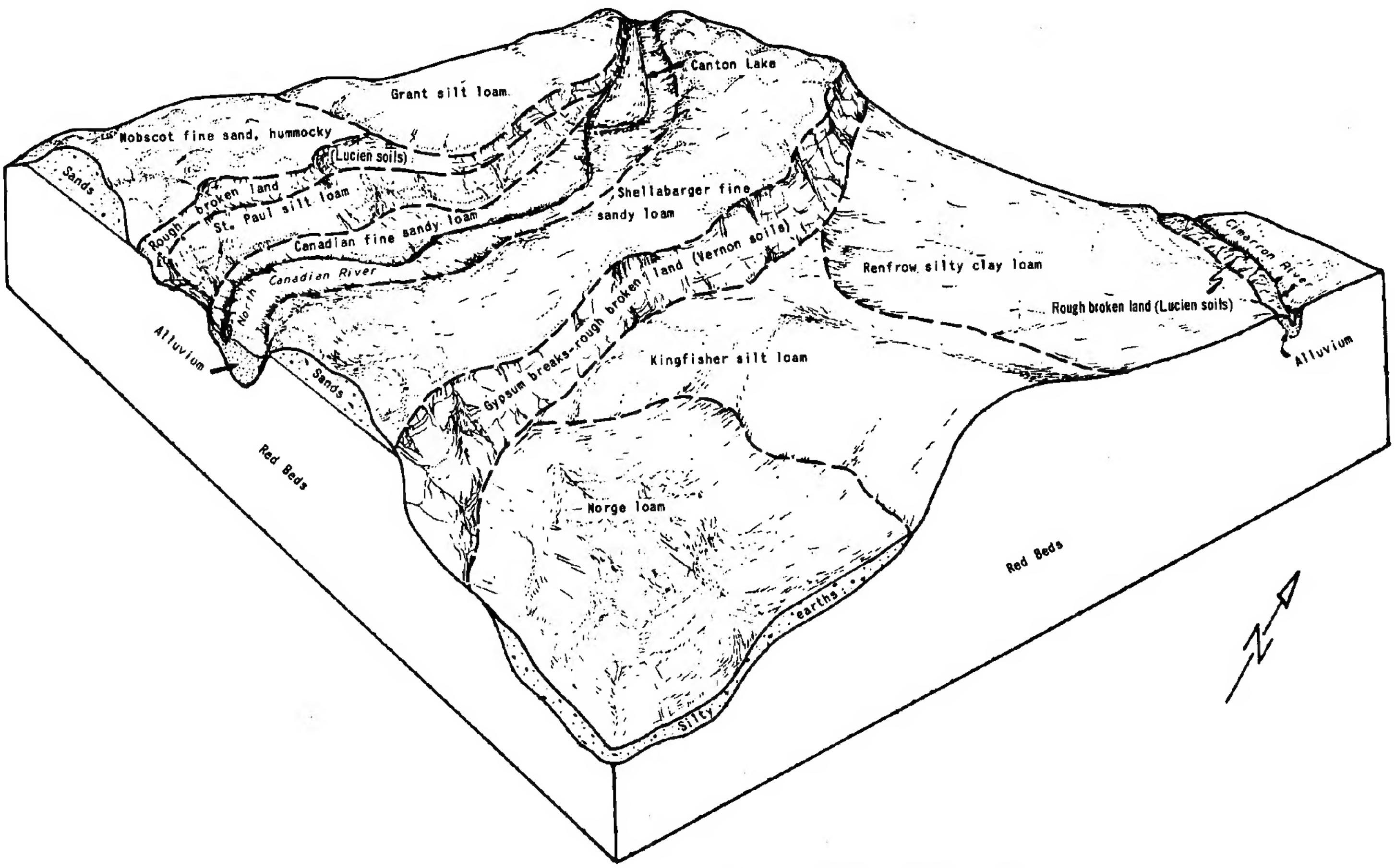

Figure 2.—**Typical pattern of soils in associations 1, 3, 4, and 6.**

Most of this association is cultivated. These are good agricultural soils that respond to careful management. Winter wheat is the principal cash crop grown on most farms. Graded roads, in good condition, run along most of the section lines.

2. Bethany-Kirkland-Tabler Association

Deep, well drained and moderately well drained, nearly level soils of the uplands; clayey subsoil

This association consists of deep, loamy soils of the uplands. These soils are, for the most part, nearly level, but they include some shallow swales. They are in two general areas, the larger one surrounding Okeene, and the other extending from near Geary northwestward to Greenfield. The total area of this association is 52,500 acres, or about 9 percent of the county.

Bethany soils make up about 35 percent of this association; Kirkland soils, 20 percent; Tabler soils, 20 percent; and minor soils the remaining 25 percent.

The soils are well drained or moderately well drained, and in permeability they range from slow to very slow. Their surface soils are slightly acid, and their subsoils and substrata are alkaline.

The Bethany soils have a dark grayish-brown to dark-brown, granular surface layer of silt loam that is 12 to 18 inches thick. The subsoil is calcareous heavy silty clay loam that ranges from dark grayish brown to brown in color and from 30 to 50 inches in thickness. The underlying loamy soil material is firm, alkaline, and difficult for plant roots to penetrate.

The Kirkland soils have a dark grayish-brown to dark-brown, granular surface layer of silt loam that is 8 to 12 inches thick. The subsoil is moderately alkaline clay that ranges from reddish brown to dark brown in color and from 20 to 50 inches in thickness. The underlying loamy or silty soil material is firm and calcareous and difficult for plant roots to penetrate.

The Tabler soils have a dark grayish-brown, granular surface soil of silty clay loam that is 6 to 8 inches thick. The subsoil, a dark grayish-brown clay, is alkaline to calcareous, and ranges from 20 to 50 inches in thickness. The underlying material is silty and calcareous and difficult for plant roots to penetrate.

Most of this association is cultivated. The soils are among the good agricultural soils of the county; they respond to good management. Winter wheat is the principal crop. Roads are on most section lines and are graded and in good condition.

3. Vernon-Lucien Association

Shallow, very gently sloping to moderately steep soils of the uplands

This association consists of two kinds of shallow upland soils, one formed from silty and clayey earths, and

the other from soft, red sandstone. These soils occur in two large areas, the larger about 5 miles east of Watonga, and the other in the southwestern part of the county along the South Canadian River (now called Canadian River). The total area of this association is about 87,500 acres, or 15 percent of the county.

Vernon soils occupy about 40 percent of this association; Lucien soils, 13 percent; and minor soils the remaining 47 percent.

The Vernon soils have a reddish-brown to red, granular surface layer of clay loam that is 6 to 12 inches thick. The subsoil ranges from clay loam to light clay in texture; it ranges from 4 to 12 inches in thickness but averages about 9 inches. Both the texture of the surface soil and subsoil and the depth of the solum vary according to the location in the county and the degree of slope.

The Lucien soils have a reddish-brown to dark reddish-brown, granular surface layer of fine sandy loam that is 6 to 12 inches thick. The subsoil is dominantly fine sandy loam. It ranges from 0 to 8 inches in thickness and averages about 6 inches. The texture of the surface soil and subsoil and the depth of the solum vary according to the location in the county and the degree of slope.

This association of shallow soils consists mainly of long, narrow, very steep outcrops of gypsum and of beds of shale and clay that cross the county diagonally in a northwest-southeast direction. This escarpment faces east and is about 200 to 300 feet high. On it are exposed three distinct beds of white gypsum interbedded with reddish-brown and grayish-green shales. Each bed of gypsum ranges from 6 to 15 feet in thickness. Deep, V-shaped canyons have been cut through this escarpment. This escarpment area, including its network of canyons, is very droughty and subject to severe erosion. The vegetation consists of only a thin stand of grass.

4. Shellabarger-Nobscot-Pratt Association

Deep, loamy to sandy, nearly level to strongly sloping soils of the uplands

This association consists of deep, loamy to sandy soils that formed in the uplands. These soils are nearly level to hummocky. They occur in two general areas. One area roughly parallels the east side of the North Canadian River, and the other area is on the divide between the two branches of the Canadian River. The total area of this association is about 122,540 acres, or 21 percent of the county.

Shellabarger soils occupy about 30 percent of this association; Nobscot soils, 25 percent; and Pratt soils, 15 percent. Minor soils, the Konawa, Teller, and Miles, occupy the remaining 30 percent.

The Shellabarger soils have a brown to dark-brown, granular surface layer of fine sandy loam that is 10 to 16 inches thick. The subsoil is slightly acid to neutral sandy clay loam of moderate, medium, subangular blocky structure. It ranges from dark yellowish brown to brown in color and from 22 to 37 inches in thickness. The underlying material consists of deep sandy loams that are friable, neutral, and easily penetrated by plant roots.

The Nobscot soils have a brown to dark grayish-brown, loose surface soil of fine sand that is 4 to 8 inches thick. The subsoil ranges from yellowish red to red in color and from 10 to 20 inches in thickness. Bands, about 2 inches thick, are in the subsoil and are of light sandy clay loam texture. The underlying material consists of deep deposits of loamy sand that have been partially reworked by the wind.

The Pratt soils have a dark brown, loose surface layer of loamy fine sand that is 4 to 12 inches in thickness. Beneath this layer is a yellowish-brown to dark-brown, neutral fine sandy loam of weak, very fine, granular structure. The underlying material consists of deep deposits of loamy fine sand that have been partially reworked by the wind. This material is loose, neutral, and very easily penetrated by plant roots.

Most of this association is cultivated where the soils are gently sloping and undulating. Soils on stronger slopes and in hummocky areas are ordinarily left in native grass. The soils of this association respond to good management. Winter wheat is the principal crop grown on these soils. Sorghums grow well on the Nobscot soils.

5. Canadian-Port-Lincoln Association

Deep, well-drained, loamy and sandy, nearly level soils of flood plains

This association consists of deep, loamy and sandy soils that formed in alluvium. These soils are nearly level and occur principally in the river valleys and in smaller areas along the larger streams. The total area of this soil association is about 70,000 acres, or 12 percent of the county.

The major soils of this association occupy about 28,650 acres. The Canadian soils make up 20 percent of the association; the Port soils, 15 percent; the Lincoln soils, 10 percent; and minor soils, 55 percent. Of the minor soils, the Dale, McLain, and Reinach are important for tilled crops, and the Wann, Leshara, Lela, and Yahola are mainly used for native grass and wildlife because they are sometimes flooded.

The Canadian, Dale, McLain, Port, and Reinach soils are mostly cultivated for tilled crops. They produce favorable yields of small grains, ordinarily winter wheat, but sorghums, cotton, and alfalfa as well.

Soils of this association vary in thickness of surface and subsoil layers, in texture, and in color. Most of these soils are moderately permeable, neutral or calcareous, and moderately easy to till. A thick stand of tall native grasses can be grown in all areas not cultivated. Bermudagrass, fescue, and other tame pasture grasses also grow well.

6. Grant-St. Paul Association

Deep, loamy, well-drained, nearly level to sloping soils of the uplands

This association consists of deep, loamy soils formed on uplands. Mostly these soils are nearly level to gently sloping, but they are strongly sloping in a few places. They lie in one general area, along the western side of

the North Canadian River. The total area of this association is about 52,500 acres, or 9 percent of the county.

Grant soils occupy 55 percent of this association; St. Paul soils, 20 percent; and Dill, Vanoss, and other minor soils, the remaining 25 percent. All soils of this association are well drained and slowly to moderately permeable. Their surface soils are neutral to slightly acid, and their subsoils and substrata are neutral to calcareous.

The Grant soils have a reddish-brown to dark-brown, granular silt loam surface layer that is 8 to 14 inches thick. The subsoil is yellowish-red to red, neutral light silty clay loam or light clay loam of moderate, medium, granular structure. Typically, the subsoil ranges from 28 to 44 inches in thickness. The underlying material is loamy and silty, firm, neutral to calcareous, and moderately difficult for plant roots to penetrate. Soft sandstone is beneath this material.

The St. Paul soils have a dark-brown, granular surface layer of silt loam that is 10 to 16 inches thick. The subsoil is moderately alkaline silty clay loam or clay loam of strong, medium, blocky structure. It ranges in color from dark grayish brown to dark brown and in thickness from 26 to 50 inches. The underlying loamy and silty material is firm, contains a little lime, and is difficult for plant roots to penetrate.

Most of this association is cultivated. The soils are suitable for cultivation and respond well to good management. Winter wheat is the principal crop on most farms. Roads follow most section lines and are graded and in good condition.

7. Dill-Minco-Nobscot Association

Moderately deep to deep, loamy and sandy soils of very gently sloping to steep uplands

This association consists of moderately deep to deep loamy and sandy soils that formed in the uplands. Mostly these soils are gently sloping, but in places they are very gently or steeply sloping and hummocky. They occur in one general area in the western part of the county. The total area of this association is about 64,000 acres, or 11 percent of the county.

Dill soils make up about 35 percent of this association; Minco soils, 20 percent; Nobscot soils, 10 percent; and small acreages of Quinlan-Woodward loams and Lucien-Rock outcrop complex, a total of 35 percent.

The soils of this association are well drained and somewhat excessively drained; permeability is moderately rapid or rapid. The surface soils are neutral or slightly acid, and the subsoils and substrata are slightly acid to calcareous.

The Dill soils have a reddish-brown to dark-brown, granular surface layer of fine sandy loam that is 8 to 14 inches thick, except where eroded. The subsoil is slightly acid fine sandy loam or light loam of moderate, medium, granular structure. It ranges from red to reddish brown in color and from 22 to 36 inches in thickness. The sloping Dill soils tend to have less clay in the subsoil than in the surface soil. The underlying material is weakly cemented soft sandstone. It is friable, calcareous along joints and bedding planes, and easily penetrated by plant roots.

The Minco soils have a brown to dark-brown, granular surface layer of very fine sandy loam or loam that is 18 to 32 inches thick. The subsoil is dark-brown, neutral loam that has weak, fine, granular structure. The underlying material is friable, calcareous sandy loam that is easily penetrated by plant roots.

The Nobscot soils have a dark grayish-brown to brown, loose surface layer of fine sand; a yellowish-red to red subsoil; and underlying deep deposits of loamy sand.

Most of this association is used to produce native grass for permanent pasture. The Nobscot soils have a cover of trees, shrubs, and grasses. The steeper slopes and hummocky areas are suited to range and as wildlife habitat.

8. Vanoss-Minco Association

Deep, loamy soils of nearly level to gently sloping high terraces

This association consists of loamy, nearly level to gently sloping soils of high terraces (fig. 3). These soils are in one large area in the southwestern part of the county. The total area of this association is about 41,000 acres, or 7 percent of the county.

Vanoss soils occupy about 50 percent of this association and Minco soils, 25 percent. Of the minor soils Pratt soils occupy 10 percent and the remaining soils, 15 percent.

The Vanoss soils have a brown to dark-brown, granular loam surface layer 10 to 18 inches thick. The subsoil is a light clay loam of weak, fine, subangular blocky structure. It ranges from brown to dark brown in color and from 28 to 50 inches in thickness. The underlying material is neutral to calcareous loam.

The Minco soils have a brown to dark-brown surface layer of very fine sandy loam or loam, a dark-brown loam subsoil, and friable, calcareous underlying material.

Pratt soils have a dark grayish-brown to dark-brown surface layer of loamy fine sand, a yellowish-brown to dark-brown subsoil of fine sandy loam, and underlying deep deposits of loamy fine sand.

Most of this association is cultivated. The soils respond to good management and are among the better agricultural soils of the county. Winter wheat is the principal crop grown on most farms. Roads are on most section lines and are graded and in good condition.

Descriptions of the Soils

Described in this section are the soil series, or groups of similar soils, and the single soils, or mapping units, in Blaine County. The soil series are described in alphabetic order. Each series is followed by a description of the soils in that series.

An important part of each soil series is a description of the layers, or horizons, in a typical profile. All the soils in one series are assumed to have essentially the same kind of profile; minor differences, if any, are pointed out in the description of each soil. Thus, to get full information about the nature of any soil, it is necessary to read both the description of that soil and the

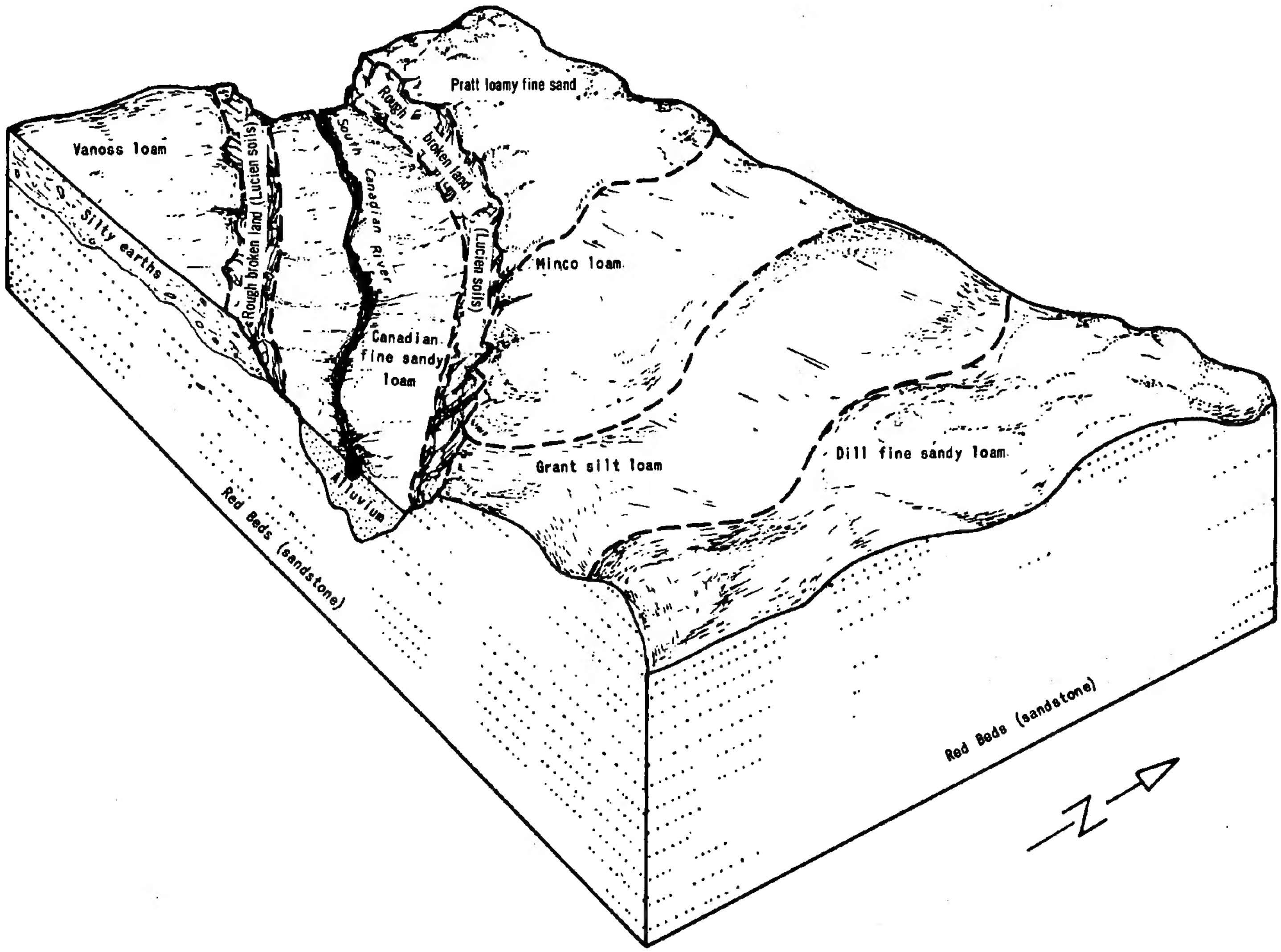

Figure 3.—**Typical pattern of soils in associations 7 and 8.**

profile description of the soil series to which the soil belongs. The descriptions of the soil series in this part of the survey are generalized. Soil scientists and others may prefer the detailed technical descriptions of soil series in the section on "Classification and Morphology of Soils."

The approximate acreage and proportionate extent of the soils are shown in table 1, and their location is shown on the detailed map at the back of this soil survey. The "Guide to Mapping Units" at the back of this publication gives a list of the soils in the county, and the capability unit, range site, and woodland suitability group into which each has been placed. Terms that may not be familiar are defined in the Glossary at the back of this survey and in the "Soil Survey Manual" (*3*).[1]

Albion Series

The Albion series consists of dark-colored, loamy soils on sloping and strongly sloping divides of the uplands. These soils are in the south-central part of the county, and about 4 miles north of the South Canadian River.

The surface layer is brown or dark-brown, neutral fine sandy loam to very gravelly loamy sand. It has weak, very fine, granular structure.

The upper part of the subsoil is a red light sandy clay loam that is massive or structureless, and the lower part is red, neutral coarse sandy loam that is also massive. The total thickness of the subsoil is about 16 inches. The subsoil is more clayey and compact in the upper part than in the lower.

The underlying material consists of thick deposits of sand and gravel that are friable, neutral, and easy for plant roots to penetrate.

Albion soils are naturally well drained. Internal drainage is medium, and permeability is moderate to moderately rapid. The ability of Albion soils to absorb and to retain moisture is low to moderate. These soils have no more than moderate natural fertility, and they are susceptible to soil blowing and water erosion.

Albion soils are not suited to cultivation and are mostly in native grass.

[1] Italic numbers in parentheses refer to Literature Cited, p. 83.

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Soil	Area	Extent
	Acres	Percent
Albion soils, 5 to 12 percent slopes	900	0.2
Bethany silt loam, 0 to 1 percent slopes	18,550	3.2
Breaks-Alluvial land complex	4,000	.7
Broken alluvial land	8,500	1.4
Canadian fine sandy loam	17,500	3.0
Carwile-Shellabarger complex, 0 to 2 percent slopes	2,800	.5
Clayey saline alluvial land	5,550	.9
Dale silt loam	6,250	1.1
Dill fine sandy loam, 0 to 1 percent slopes	1,900	.3
Dill fine sandy loam, 1 to 5 percent slopes	6,000	1.0
Dill fine sandy loam, 5 to 8 percent slopes	10,350	1.8
Dill fine sandy loam, 5 to 8 percent slopes, eroded	5,850	1.0
Eroded loamy land	5,500	.9
Farnum fine sandy loam, 0 to 3 percent slopes	2,750	.5
Grant silt loam, 1 to 3 percent slopes	8,000	1.4
Grant silt loam, 3 to 5 percent slopes	16,200	2.8
Grant silt loam, 5 to 8 percent slopes	3,450	.6
Grant silt loam, 4 to 8 percent slopes, eroded	2,650	.5
Kingfisher silt loam, 0 to 1 percent slopes	1,350	.2
Kingfisher silt loam, 1 to 3 percent slopes	6,950	1.2
Kingfisher-Grant silt loams, 3 to 5 percent slopes	1,250	.2
Kingfisher-Lucien complex, 4 to 8 percent slopes, eroded	8,150	1.4
Kingfisher-Slickspots complex, 1 to 3 percent slopes	1,850	.3
Kirkland silt loam, 0 to 1 percent slopes	10,300	1.8
Konawa loamy fine sand, undulating	5,050	.9
Konawa loamy fine sand, hummocky	10,300	1.8
Lela clay, wet	3,250	.6
Lela, wet-Slickspots complex	1,300	.2
Leshara-Slickspots complex	2,250	.4
Lincoln loamy fine sand	7,850	1.3
Lucien-Rock outcrop complex	11,700	2.0
McLain silty clay loam	5,000	.9
Miles fine sandy loam, 1 to 3 percent slopes	1,200	.2
Miles fine sandy loam, 3 to 5 percent slopes	800	.1
Minco loam, 0 to 1 percent slopes	2,150	.4
Minco loam, 1 to 3 percent slopes	7,800	1.3
Minco loam, 3 to 5 percent slopes	4,100	.7
Minco very fine sandy loam, 3 to 8 percent slopes	6,850	1.2
Minco very fine sandy loam, steep	9,000	1.5
Nobscot fine sand, undulating	6,650	1.1
Nobscot fine sand, hummocky	29,900	5.1
Nobscot fine sand, rolling	1,000	.2
Norge loam, 0 to 1 percent slopes	7,200	1.2
Norge loam, 1 to 3 percent slopes	14,150	2.4
Norge loam, 3 to 5 percent slopes	6,400	1.1
Norge loam, 5 to 8 percent slopes	1,450	.2
Norge-Slickspots complex, 0 to 3 percent slopes	4,650	.8
Port clay loam	5,000	.9
Port loam	8,300	1.4
Pratt loamy fine sand, undulating	15,200	2.6
Pratt loamy fine sand, hummocky	9,300	1.6
Quinlan-Woodward loams, 5 to 20 percent slopes	17,000	2.9
Reinach very fine sandy loam	2,050	.4
Renfrow silty clay loam, 0 to 1 percent slopes	2,200	.4
Renfrow silty clay loam, 1 to 3 percent slopes	15,900	2.7
Renfrow-Vernon complex, 3 to 5 percent slopes, eroded	12,450	2.1
Rough broken land	11,900	2.0
Sandy broken land	8,150	1.4
Shellabarger fine sandy loam, 0 to 3 percent slopes	23,600	4.0
Shellabarger fine sandy loam, 3 to 5 percent slopes	13,950	2.4
Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes	3,150	.5
Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes, eroded	1,700	.3
St. Paul silt loam, 0 to 1 percent slopes	3,650	.6
St. Paul silt loam, 1 to 3 percent slopes	7,350	1.3
Tabler silty clay loam	9,650	1.7
Teller fine sandy loam, 1 to 3 percent slopes	1,600	.3
Teller fine sandy loam, 3 to 5 percent slopes	3,150	.5
Tivoli fine sand, rolling	7,150	1.2
Vanoss loam, 0 to 1 percent slopes	11,600	2.0
Vanoss loam, 1 to 3 percent slopes	10,000	1.7
Vernon clay loam, 1 to 3 percent slopes	3,000	.5
Vernon clay loam, 3 to 5 percent slopes	5,150	.9
Vernon soils and Rock outcrop	28,300	4.9
Wann soils	3,850	.7
Wet alluvial land	7,350	1.3
Yahola loam	2,000	.3
Canton Lake and other non-agricultural land	22,840	4.0
Total	583,040	100.0

Albion soils, 5 to 12 percent slopes (AbE).—Most areas of these soils are strongly sloping, but there are some steep, gravelly outcrops. The strong slopes are susceptible to severe sheet and gully erosion unless well protected. These soils are in small areas on stream divides near the South Canadian River.

Included with these soils in mapping were small areas of Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes, totaling about 5 percent of the acreage, and areas of deep, gravelly outcrops covering about 5 percent.

Albion soils are well suited to permanent grasses for pasture and provide suitable habitats for wildlife. Sand bluestem and little bluestem are the most productive range grasses. Low water-holding capacity and susceptibility to erosion make these soils unsuitable for cultivated crops. (Capability unit VIe–2; Sandy Prairie range site; woodland suitability group 4)

Bethany Series

Deep, dark-colored, silty soils on nearly level uplands make up the Bethany series. These soils are in the north-central and southeastern parts of the county.

The surface layer is dark grayish-brown or dark-brown, slightly acid silt loam. This layer is of granular structure, is about 14 inches thick, and is moderately easy to till.

The upper part of the subsoil is a dark grayish-brown or dark-brown light silty clay loam of moderate, fine, subangular blocky structure. The lower part is dark grayish-brown or brown, moderately alkaline heavy silty clay loam of moderate, medium, blocky structure. The total thickness of the subsoil is about 50 inches. The subsoil is less clayey and compact in the upper part than in the lower.

The underlying material is silty, limy, and firm; it restricts penetration of plant roots.

Bethany soils are naturally well drained. Internal drainage is medium, and permeability is slow. Their water-holding capacity is high, and their ability to retain moisture is moderate. These soils have high natural fertility.

Most areas of Bethany soils are cultivated. They are suited to small grains, sorghums, cotton, legumes, and grass. Winter wheat is the crop most widely grown.

Bethany silt loam, 0 to 1 percent slopes (BeA).—This soil is nearly level, and most of it lies where rainfall is near the maximum for the uplands.

All of this soil, except a few small areas in native grass, is now cultivated. This soil is one of the most desirable in the county for small grains. Winter wheat is the principal crop. All crop residue should be returned to the soil, but excessive tillage should be avoided. A light application of fertilizer is often used to maintain or to increase the yield of wheat. (Capability unit I–2; Loamy Prairie range site; woodland suitability group 2)

Breaks-Alluvial Land Complex

Breaks-Alluvial land complex (Bk) consists of soils on short side slopes along shallow intermittent drainageways that flow into the larger creeks. These soils occupy long, narrow areas. Slopes range from 5 to 20 percent.

Vernon-like soils material occupies the drainageways, except for the narrow strips on the stream floors where alluvium has been deposited. The narrow, irregular strips of alluvium border the stream channels. This alluvium is stratified. The layers range from reddish brown to dark brown in color and from fine sandy loam to clay in texture. In most places this alluvium is silt loam and is neutral or mildly alkaline. Depth to bedrock ranges from 10 inches to 7 feet. In some places the stream channel has cut through the alluvium and exposed the underlying red beds. In many places short, steep slopes merge with nearly level areas to form a step-like descent to the alluvium of the stream floor.

Many of these areas are unproductive because of geologic erosion and slight to moderate accelerated erosion. Nearly all of this mapping unit is in native grass, which provides a cover to protect the soils. (Capability unit VIe–3; Breaks part in Red Clay Prairie range site, and Alluvial land in Loamy Bottom Land range site; woodland suitability group 2)

Broken Alluvial Land

Broken alluvial land (Br) consists of reddish-brown, friable loamy alluvium. It lies in narrow strips along the sides of streams that have cut deep channels 100 to 200 feet wide. The steep banks are as much as 25 feet high in places, but average about 10 feet.

This land supports a thick stand of trees, mainly elm and cottonwood, and a mixed undergrowth, including some shrubs and tall grasses. It provides grazing and a habitat for wildlife. Protection is needed from overgrazing, from extensive clearing of trees, and from fire, so as to lessen further erosion and widening of stream channels. (Capability unit Vw–2; Loamy Bottom Land range site; woodland suitability group 2)

Canadian Series

Deep, dark-colored, nearly level, loamy soils make up the Canadian series. These soils are along the North and South Canadian Rivers.

The surface layer is brown or dark-brown, medium acid, easily tilled fine sandy loam of granular structure. This layer is about 16 inches thick.

The subsoil is dark-brown, slightly acid fine sandy loam that has moderate, fine, granular structure.

The underlying material is friable loamy alluvium that is about neutral and is easy for plant roots to penetrate.

Canadian soils are naturally well drained. Internal drainage is medium, and permeability is moderately rapid. The ability of these soils to absorb and hold moisture is moderate, and they are medium in natural fertility. When tilled, they are susceptible to wind erosion.

Most areas of Canadian soils are cultivated. They are suited to small grains, grain sorghums, cotton, alfalfa, and grass. Winter wheat is the principal crop.

Canadian fine sandy loam (Ca).—This soil is nearly level and easy to till. Included with it in mapping were small areas of Reinach very fine sandy loam totaling about 3 to 5 percent of the acreage, areas of Dale silt loam covering about 2 to 3 percent, and areas of McLain silty clay loam covering about 1 percent.

Most of this soil is cultivated, and a few small areas are in native grass. Winter wheat is the principal crop. Other crops are sorghums, cotton, and alfalfa.

Occasionally, small areas of this soil are flooded for short periods. The floods cause little damage, but runoff from higher land may cause erosion in some places and accumulation of recent sediments in others. The principal problems of soil management are water conservation and protection against slight to moderate wind erosion. (Capability unit I–1; Loamy Bottom Land range site; woodland suitability group 1)

Carwile Series

In the Carwile series are deep, dark-colored, nearly level, loamy soils of the uplands. These soils are in the northwestern part of the county.

The surface layer is dark-brown or grayish-brown, slightly acid fine sandy loam. This layer is about 8 inches thick and is moderately easy to till.

The upper part of the subsoil is a dark grayish-brown sandy clay loam of weak, medium, granular structure. The lower part is brown, neutral heavy sandy clay loam of moderate, medium, blocky structure. The subsoil contains more clay and is more compact in the lower part than in the upper. The total thickness of the subsoil is about 24 inches.

The underlying material is firm, neutral, mottled sandy loam that is moderately difficult for plant roots to penetrate.

Carwile soils are somewhat poorly drained. Internal drainage is slow, and permeability is slow. The ability to hold and retain moisture is moderate.

About one-half of the acreage of Carwile soils is cultivated. These soils are suited to small grains, sorghums, cotton, cowpeas, and grass. Winter wheat is the principal crop.

Carwile-Shellabarger complex, 0 to 2 percent slopes (CsA).—This complex is principally made up of Carwile and Shellabarger fine sandy loams.

The Carwile soils of this complex are in shallow swale areas, and they occupy 40 to 60 percent of the complex. The Shellabarger soils are at the highest elevations within this complex and occupy 20 to 30 percent of it.

Most areas of this complex are cultivated. Winter wheat is the principal crop, and sorghums, cotton, legumes, and grass are also grown.

Excess water that ponds and damages crops is fairly common on the Carwile part of this complex. Another concern is the wind erosion that occurs on all parts of this complex where clean tillage is excessive or where crop residues are lacking. Some of the management practices that help to lessen damage by wind erosion are minimum tillage, stubble mulching, and stripcropping. (Capability unit IIw–2; Carwile soil in Loamy Prairie range site, and Shellabarger soil in Sandy Prairie range site; woodland suitability group 1)

Clayey Saline Alluvial Land

Clayey saline alluvial land (Cy) is made up of fine-textured alluvium spotted with saline areas. It formed in recent alluvium along some of the large creeks that drain out of the clayey red beds. Slope is less than 1 percent.

The surface layer is red to reddish-brown, calcareous clay 4 to 8 inches thick. This layer grades to red, stratified clayey and sandy layers.

This soil is suited to grazing. Nearly all of it is in native grass. The most productive grasses are switchgrass, alkali sacaton, and western wheatgrass. Where this soil is tilled, crop yields are low. (Capability unit Vs–1; Alkali Bottom Land range site; woodland suitability group 4)

Dale Series

Deep, dark-colored, nearly level soils make up the Dale series. These soils are on benches along the North Canadian River.

The surface layer is dark grayish-brown or brown, medium acid silt loam of granular structure. It is about 14 inches thick and is easy to till.

The upper part of the subsoil is a brown silt loam of moderate, fine, granular structure. The lower part is brown or dark yellowish-brown, moderately alkaline silt loam of moderate, fine, granular structure. The subsoil is a little more clayey in the lower part than in the upper. The total thickness of the subsoil is about 12 inches.

The underlying material is medium-textured alluvium, which is friable and easy for plant roots to penetrate.

The texture of the surface and subsoil layers of the Dale soils varies slightly according to the location in the county and the degree of slope.

Dale soils are naturally well drained. Internal drainage is medium. The ability of these soils to absorb and retain moisture is moderate. These soils have high natural fertility.

Most areas of Dale soils are cultivated. Winter wheat is the crop most widely grown, but these soils are also suited to small grains, cotton, sorghums, alfalfa, and grass.

Dale silt loam (Da).—This soil is nearly level and easy to till. Included with it in mapping were small areas of Canadian fine sandy loam totaling about 5 percent of the acreage and areas of McLain silty clay loam covering about 2 percent.

Most areas of this soil are cultivated. Only a few small areas are in native grass. Winter wheat is the principal crop, but this soil is also suited to sorghums, cotton, and alfalfa.

Occasionally some areas of this soil are temporarily flooded, but damage by runoff from higher land is only slight. During these floods, some areas are eroded and sediment accumulates in other areas.

The main concerns of soil management are water conservation and maintenance of soil structure and fertility. (Capability unit I–1; Loamy Bottom Land range site; woodland suitability group 1)

Dill Series

Deep, very gently sloping to sloping loamy soils of the uplands make up the Dill series. These soils are in the northwestern and southern parts of the county.

The surface layer is a reddish-brown or dark-brown, slightly acid, easily tilled fine sandy loam of granular structure. It is about 10 inches thick.

The upper part of the subsoil is a reddish-brown or red, slightly acid fine sandy loam of moderate, medium, granular structure. The lower part is similar to the upper part, except that it contains less clay. The subsoil is about 30 inches thick.

The underlying material consists of weakly consolidated sandstone. The part of the sandstone that is friable and calcareous along the joints and bedding planes is easily penetrated by plant roots.

Dill soils are well drained. Internal drainage is rapid, and permeability is moderately rapid. The water-holding capacity of these soils is moderate, and their ability to retain soil moisture is low. These soils are of medium natural fertility, but when they are tilled they are susceptible to water and wind erosion.

About one-half of the acreage of Dill soils is cultivated. The soils are suited to small grains, grain sorghums, cotton, legumes, and grass. Winter wheat is the crop most widely grown.

Dill fine sandy loam, 0 to 1 percent slopes (DfA).—This soil is on nearly level uplands in the northwestern part of the county. It is closely associated with Dill fine sandy loam, 1 to 5 percent slopes. The principal difference between the two is slope.

Included with this soil in mapping were areas totaling about 2 percent each of Lucien-Rock outcrop complex and Quinlan soils, and about 3 to 4 percent of Grant silt loam, 1 to 3 percent slopes.

Most of this soil is cultivated to small grains, sorghums, and cotton. This soil needs the protection provided by cover crops and by control of runoff. (Capability unit IIe-2; Sandy Prairie range site; woodland suitability group 1)

Dill fine sandy loam, 1 to 5 percent slopes (DfB).—This soil is very gently to gently sloping and easy to till. About three-fourths of it is tilled. It has the profile described as typical of the series.

Included with this soil in mapping were areas of Grant silt loam, 1 to 3 percent slopes, totaling about 6 to 8 percent of the acreage, and areas of Lucien and Quinlan soils covering 1 to 2 percent each.

Where this soil is cultivated, winter wheat is the principal crop and grain sorghums and cotton the minor crops. Native grasses grow in areas not cultivated.

Some of the problems of soil management are conserving water and protecting the soil from slight to moderate wind and water erosion. Some of the management practices that this soil will respond to are minimum tillage, use of crop residues, and stripcropping practiced along with terracing and contour farming. (Capability unit IIIe-2; Sandy Prairie range site; woodland suitability group 2)

Dill fine sandy loam, 5 to 8 percent slopes (DfD).—This soil is on sloping, eroded uplands in the northwestern and southern parts of the county. It is associated with Grant silt loams and Shellabarger-Teller fine sandy loams on slopes of similar gradient.

Included with this soil in mapping were areas of Grant silt loam, 5 to 8 percent slopes, that occupy about 6 to 8 percent of the acreage, and of Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes, covering 2 to 3 percent.

Nearly all of this soil is in native grass. Where the soil is cultivated, stubble mulching, wind stripcropping, contour tillage, growing of cover crops, and similar soil conserving practices are needed. (Capability unit IVe-6; Sandy Prairie range site; woodland suitability group 3)

Dill fine sandy loam, 5 to 8 percent slopes, eroded (DfD2).—This soil is on sloping, eroded uplands and side slopes that grade to the main intermittent drainageways. Most of this soil is in the northwestern, southwestern, and southern parts of the county. It is associated with Grant silt loams and Shellabarger-Teller fine sandy loams on slopes of similar gradient.

Included with this soil in mapping were areas of Grant silt loam, 4 to 8 percent slopes, eroded, totaling about 6 to 8 percent of the acreage, and of Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes, eroded, covering about 2 to 3 percent.

This soil differs from the soil described for the Dill series mainly in having a thinner surface layer. On much of this soil, erosion has removed 25 to 50 percent of the original surface soil and left a surface layer 5 to 8 inches thick. All of the surface layer has been removed from about 5 percent of this soil. In plowed fields, 50 to 65 percent of the acreage has a plow layer that is a mixture of the original surface soil and the upper part of the subsoil. Where runoff accumulates, gullies form and gradually work their way up the slopes. These gullies ordinarily are not more than 500 feet apart and cannot be filled by normal tillage. In addition to the gullies, there are numerous small rills.

Most of this soil is in native grass. Where it is cultivated, winter wheat is the principal crop. Where it is tilled, this soil should be kept in close-growing crops every year. Cotton, sorghums, or other row crops should not be grown on this soil, because they return little residue. (Capability unit IVe-4; Sandy Prairie range site; woodland suitability group 3)

Eroded Loamy Land

Eroded loamy land (Er) consists of areas of formerly cultivated soils that are now severely eroded. Most areas of this land are on gently sloping ridgetops and on moderate to strong slopes. Among the original soils of these eroded areas were those of the Nobscot, Konawa, Shellabarger, Teller, Dill, and Grant series.

The thin surface layer ranges from loam to fine sandy loam. Erosion continues on most areas once tilled, and there are gullies 3 to 5 feet deep and 50 to 100 feet apart.

Eroded loamy land supports a meager stand of poor-quality native grass and is used for grazing. It would produce more if seeded to the native grasses that grow well in this area. (Capability unit VIe-5; Loamy Prairie range site; woodland suitability group 4)

Farnum Series

Deep, dark-colored, nearly level to very gently sloping loamy soils of the uplands are in the Farnum series. These soils are in the northwestern part of the county.

The surface layer is brown or dark-brown, slightly acid fine sandy loam. The upper part of this layer is of granular structure, is about 12 inches thick, and is easy to till; the lower 12 inches is friable loam.

The upper part of the subsoil is a dark-brown heavy silty clay loam of moderate, medium, blocky structure.

The lower part is dark grayish-brown, neutral silty clay loam of moderate, medium, blocky structure. This layer is more compact and clayey in the upper part than in the lower. The total thickness of the subsoil is about 40 inches.

The underlying material is friable, silty or loamy, low in lime content, and moderately difficult for plant roots to penetrate.

Farnum soils are naturally well drained. Internal drainage is medium, and permeability is moderately slow. The ability of these soils to absorb and hold moisture is moderate. These soils are high in natural fertility but, when tilled, are susceptible to both wind and water erosion.

Most areas of Farnum soils are cultivated. They are suited to small grains, sorghums, cotton, legumes, and grass. Winter wheat is the crop most widely grown.

Farnum fine sandy loam, 0 to 3 percent slopes (FaA).—This soil is nearly level to gently sloping, easy to till, and desirable for farming. Included with this soil in mapping were small areas of Shellabarger fine sandy loam, 0 to 3 percent slopes, that total about 5 percent of the acreage.

Except for a few small areas in native grass, most of this soil is tilled. Winter wheat is the principal crop. The main concerns of soil management are conserving water and protecting the soil from slight to moderate wind and water erosion. Excessive tillage should be avoided. Among the management practices this soil responds to are stubble mulching and the use of crop residue. (Capability unit IIe–2; Loamy Prairie range site; woodland suitability group 2)

Grant Series

Deep, gently sloping soils of the uplands make up the Grant series. These soils are mostly in the northwestern, south-central, and southeastern parts of the county.

The surface layer is reddish-brown or dark-brown, slightly acid silt loam. This layer is of granular structure, is about 12 inches thick, and is easy to till.

The upper part of the subsoil is reddish-brown, neutral light silty clay loam of moderate, medium, granular structure. The lower part is red or reddish-brown, neutral light silty clay loam of moderate, medium, granular structure. The total thickness of the subsoil is about 36 inches.

The underlying material is soft sandstone; it is firm, neutral to limy, and moderately difficult for plant roots to penetrate.

Grant soils are naturally well drained. Internal drainage is medium, and permeability is moderate. Their ability to absorb and retain moisture is moderate. These soils have high natural fertility but, when tilled, are susceptible to water erosion.

Most areas of Grant soils are cultivated. They are suited to small grains, grain sorghums, cotton, legumes, and grass. Winter wheat is the crop most widely grown.

Grant silt loam, 1 to 3 percent slopes (GrB).—This soil is very gently sloping and desirable for farming. It has the profile described as typical of the series.

Included with this soil in mapping were small areas of Dill fine sandy loam, 1 to 5 percent slopes, totaling about 5 to 7 percent of the acreage, and of Teller fine sandy loam, 1 to 3 percent slopes, covering about 2 or 3 percent.

Except for a few small areas in native grass, most of this soil is tilled. Winter wheat is the principal crop. This soil needs the protection from runoff that can be had by terracing, contour farming, or similar practices. (Capability unit IIe–1; Loamy Prairie range site; woodland suitability group 2)

Grant silt loam, 3 to 5 percent slopes (GrC).—This soil is on gently sloping, eroded uplands in the southwestern, northwestern, and southern parts of the county. It is closely associated with the very gently sloping Grant and Dill soils.

Included with this soil in mapping were small areas of Teller fine sandy loam, 3 to 5 percent slopes, totaling about 3 percent of the acreage, and areas of Dill fine sandy loam covering about 5 to 7 percent.

This soil differs from Grant silt loam, 1 to 3 percent slopes, mainly in depth of solum and thickness of surface layer. The surface layer of this soil is reddish-brown to dark-brown silt loam 7 to 10 inches thick.

Most areas of this soil are cultivated. Winter wheat is the principal crop. Where this soil is cultivated, crop residue management and stripcropping, practiced along with terracing and contour farming, are needed. (Capability unit IIIe–1; Loamy Prairie range site; woodland suitability group 2)

Grant silt loam, 5 to 8 percent slopes (GrD).—This soil is on sloping, eroded uplands in the northwestern, southwestern, and southern parts of the county. It is associated, on strong slopes, with Dill fine sandy loams and Shellabarger-Teller fine sandy loams. The principal difference between this soil and Grant silt loam, 3 to 5 percent slopes, is slope.

Included with this soil in mapping were small areas of Dill fine sandy loam, 5 to 8 percent slopes, that occupy about 6 to 8 per cent of the acreage, and of Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes, covering about 5 percent.

The surface layer of Grant silt loam, 5 to 8 percent slopes, is reddish-brown to dark-brown silt loam that ranges from 7 to 10 inches in thickness.

The upper subsoil is reddish-brown to yellowish-red loam to heavy silt loam that ranges from 6 to 9 inches in thickness. The lower subsoil is red to yellowish-red heavy loam to light silty clay loam that is 8 to 12 inches thick.

The underlying material is red to dark reddish-brown fine sandy loam or silt loam, which, in many places grades to soft sandstone at a depth of about 50 inches. Where this soil has formed in silty material, the depth to the sandstone rock may be several feet.

This soil is well suited to permanent grass for pasture. Where tilled, intensive conservation measures are needed on the steep slopes to protect the soil from erosion. (Capability unit IVe–2; Loamy Prairie range site; woodland suitability group 3)

Grant silt loam, 4 to 8 percent slopes, eroded (GrD2).—This soil is on gently sloping to sloping, eroded uplands in the northwestern, southwestern, and southern parts of the county. It is associated with Dill fine sandy loams and Shellabarger-Teller fine sandy loams, on slopes of similar gradient.

Included with this soil in mapping were areas of Dill fine sandy loam, 5 to 8 percent slopes, totaling about 6 to 8 percent of the acreage, and of Shellabarger-Teller fine sandy loams covering about 5 to 8 percent.

This soil differs from Grant silt loam, 5 to 8 percent slopes, mainly in having a thinner surface layer. The surface layer is red to reddish-brown silt loam to heavy loam.

On much of this soil, erosion has removed 25 to 50 percent of the original surface soil and left a surface layer 4 to 8 inches thick. On about 2 percent of the acreage, all of the surface layer has been removed and the subsoil is exposed. In plowed fields, 40 to 50 percent of the acreage has a plow layer that is a mixture of the original surface soil and the upper part of the subsoil.

Nearly all of this soil is cultivated. Winter wheat is the main crop. Among the management practices that help to protect this soil from further erosion are terracing and contour farming. This soil is better suited to grass than to cultivated crops. Where cultivated, it should be kept in close-growing crops every year. (Capability unit IVe-4; Loamy Prairie range site; woodland suitability group 3)

Kingfisher Series

Deep soils on nearly level to sloping uplands make up the Kingfisher series. These soils are in the northeastern part of the county.

The surface layer is reddish-brown, medium acid silt loam. This layer is of granular structure, is about 12 inches thick, and is moderately difficult to till.

The upper part of the subsoil is a reddish-brown light silty clay loam of moderate, fine, subangular blocky structure. The lower part is reddish-brown, neutral heavy silty clay loam of moderate, medium, subangular blocky structure. The subsoil contains more clay and is more compact in the lower part than in the upper. The total thickness of the subsoil is about 30 inches.

The silty underlying material is calcareous along the joints and bedding planes, and plant roots follow these lines of weakness.

Kingfisher soils are naturally well drained. Internal drainage is medium, and permeability is moderately slow. The ability of these soils to hold and to retain moisture is moderate. These soils have high natural fertility but, when tilled, are susceptible to water erosion.

Most areas of Kingfisher soils are cultivated. The soils are suited to wheat, barley, oats, and other small grains, as well as to sorghums, cotton, legumes, and native grass. Winter wheat is the crop most widely grown.

Kingfisher silt loam, 0 to 1 percent slopes (KfA).—This is a nearly level soil desirable for farming. It has the profile described as typical of the series.

Included with this soil in mapping were small areas of Renfrow silty clay loam, 0 to 1 percent slopes, and of Grant silt loam, 1 to 3 percent slopes. Each included soil totals about 4 percent of the acreage.

Most areas of this soil are tilled; only a few small areas are in native grass. Winter wheat is the principal crop.

All crop residue should be returned to the soil and excessive tillage avoided. Many farmers apply a small amount of fertilizer to wheat. (Capability unit I-2; Loamy Prairie range site; woodland suitability group 2)

Kingfisher silt loam, 1 to 3 percent slopes (KfB).—This soil is on very gently sloping, eroded uplands. It is associated with the nearly level Kingfisher silt loam and nearly level Renfrow silty clay loam.

Included with this soil in mapping were small areas of Renfrow silty clay loam, 1 to 3 percent slopes, that total about 5 percent of the acreage. Also included were isolated slickspots, which are indicated on the map sheets by the symbol for gumbo or scabby spots.

The surface layer is reddish-brown to dark reddish-brown silt loam that is about 8 to 12 inches thick. The subsoil ranges from reddish brown to dark reddish brown. The upper part of the subsoil is about 5 inches of silty clay loam. The lower part ranges from silty clay loam to heavy silty clay loam. Depth to the soft sandstone is about 42 inches.

Most of this soil is cultivated. Winter wheat is the principal crop. Terracing and contour farming are necessary practices for protecting this soil from runoff. Fertility can be increased by applying fertilizer or a soil-improving crop rotation. (Capability unit IIe-3; Loamy Prairie range site; woodland suitability group 2)

Kingfisher-Grant silt loams, 3 to 5 percent slopes (KgC).—This mapping unit is made up of 40 to 65 percent Kingfisher silt loam and 35 to 65 percent Grant silt loam. These soils are on gently sloping, eroded uplands in the northeastern part of the county. They are associated with the nearly level and very gently sloping soils of the Kingfisher, Grant, and Renfrow series.

Included with these soils in mapping were small areas of Kingfisher-Lucien complex, 4 to 8 percent slopes, eroded, totaling about 5 percent of the acreage. Also included were isolated slickspots.

The Kingfisher soils have a surface layer about 6 to 10 inches thick and are about 42 inches deep to sandstone. The Grant soils have a surface layer about 7 to 10 inches thick.

About three-fourths of this mapping unit is cultivated; the rest is in native grass. Winter wheat is the principal crop. Effective management includes maintaining soil structure and fertility by planting small grains in rotation with legumes or by using fertilizers, and controlling water erosion by using terracing and contour farming. (Both soils in capability unit IIIe-1; Loamy Prairie range site; woodland suitability group 2)

Kingfisher-Lucien complex, 4 to 8 percent slopes, eroded (KhD2).—This complex is on sloping, eroded uplands in the northeastern part of the county. It consists of about 75 percent Kingfisher silt loam, and about 25 percent Lucien-Rock outcrop complex. The isolated slickspots in this complex are shown on the map by the symbol for a gumbo or scabby spot.

Most areas of this complex are cultivated. Winter wheat is the principal crop. The soils are better suited to permanent grass for pasture than to small grains. When tilled, these soils require intensive conservation practices, mainly because of their slope and tendency to erode. (Capability unit IVe-4; Kingfisher soil in Loamy Prairie range site, and Lucien soil (with Rock outcrops) in Shallow Prairie range site; woodland suitability group 3)

Kingfisher-Slickspots complex, 1 to 3 percent slopes (KlB).—About 60 to 80 percent of this complex is made up of Kingfisher silt loam, 10 to 25 percent is slickspots, and 10 to 25 percent is soils that have characteristics intermediate between Kingfisher silt loam and slickspots.

Included in the mapping of these soils were small areas of Grant silt loams and Lucien soils that total about 5 percent of the acreage.

The surface soil of Kingfisher silt loam is reddish brown to dark reddish brown and about 8 to 12 inches thick. The subsoil ranges from reddish brown to dark reddish brown. The upper part of the subsoil is about 5 inches thick, and the texture of the lower part ranges from silty clay loam to heavy silty clay loam.

The surface soil of the slickspots is a grayish-brown to dark yellowish-brown, calcareous or noncalcareous silt loam to silty clay loam. This layer is 2 to 10 inches thick. Beneath the surface layer is a subsoil of weak blocky to massive clay loam to clay.

In areas where slickspots are abundant, the surface layer is saline and alkaline, or saline, or alkaline. Where there are fewer areas of slickspots, the surface layer is probably neither saline nor alkaline; but, at some depth, likely the subsoil is either saline and alkaline, saline, or alkaline. A hard, glazed, whitish surface crust, 1/4 to 1 inch thick, forms when the soil drys after a rain. These slickspots are nearly circular to irregular in shape and they cover areas of 1/10 acre to 3 acres.

Crop yields are favorable on the Kingfisher soils of this complex, but they are poor on the slickspots because of the crust that forms on the surface. Special mulching on the slickspots consists of applying 3 to 5 tons of gypsum per acre. Areas treated should not be cultivated for at least 2 years. (Capability unit IIIs-1; Kingfisher soil in Loamy Prairie range site, and Slickspots in Slickspot range site; woodland suitability group 3)

Kirkland Series

Deep, dark-colored soils on nearly level to very gently sloping uplands make up the Kirkland series. These soils are in the northeastern part of the county.

The surface layer is dark-brown or dark grayish-brown, slightly acid silt loam of granular structure (fig. 4). This layer is about 10 inches thick and is moderately easy to till.

The upper part of the subsoil is a dark-brown clay of moderate, medium, blocky structure. The lower part is dark-brown, calcareous heavy silty clay loam of weak, medium, blocky structure. The upper part of the subsoil is more compact and contains more clay than the lower. The total thickness of the subsoil is about 28 inches.

The underlying material is firm, calcareous, silty, and difficult for plant roots to penetrate.

These soils are naturally well drained. Internal drainage is medium, and permeability is very slow. The ability of these soils to absorb and retain moisture is moderate. These soils have high natural fertility.

Most areas of Kirkland soils are cultivated. They are suited to small grains, including wheat, barley, and oats, sorghums, legumes, and native grasses. Winter wheat is the crop most widely grown.

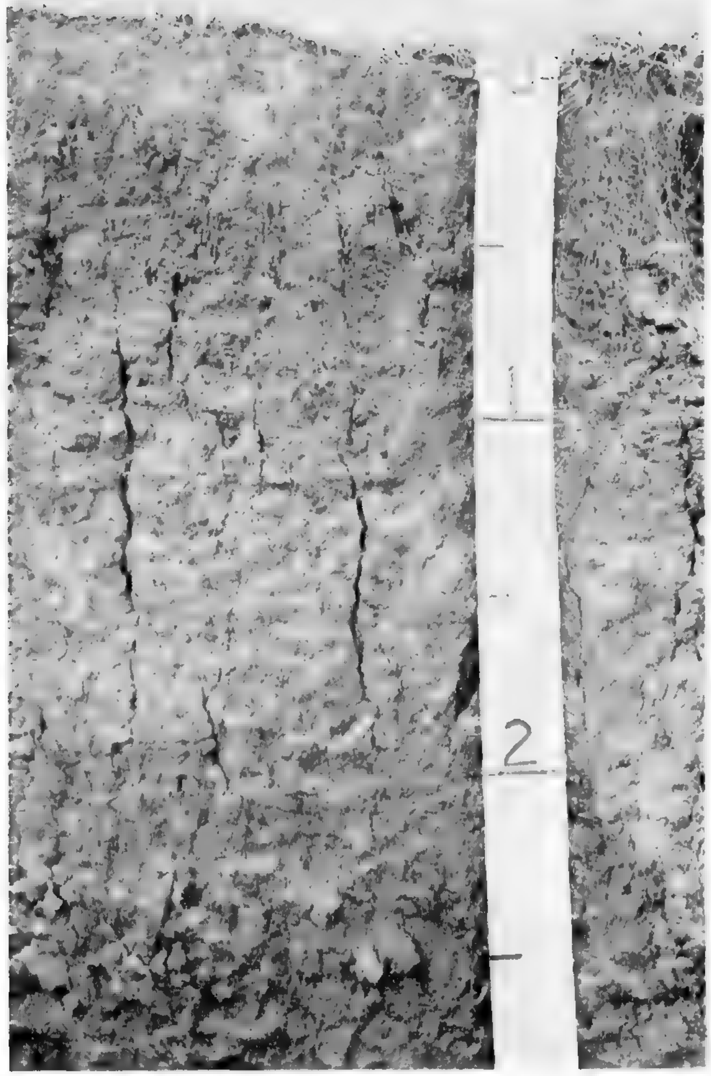

Figure 4.—Profile of Kirkland silt loam.

Kirkland silt loam, 0 to 1 percent slopes (KrA).—This nearly level soil is one of the more desirable in the county for small grains.

Included with this soil in mapping were small areas of Renfrow silty clay loam, 0 to 1 percent slopes, that total about 5 percent of the acreage; of Bethany silt loam, 0 to 1 percent slopes, covering about 3 percent; and of Tabler silty clay loam, 0 to 1 percent slopes, covering about 2 percent.

All of this soil, except for a few small areas in grass, is cultivated. Slickspots occur in some places.

This soil is suited to shallow-rooted crops. A claypan layer restricts water and root penetration. The cropping system ought to include deep-rooted legumes, such as sweetclover or alfalfa. Minimum tillage, stubble mulching, and crop residue management are practices that will help in the absorption and storage of moisture for crop production. (Capability unit IIs-1; Claypan Prairie range site; woodland suitability group 3)

Konawa Series

The Konawa series consists of deep, timbered soils that have a sandy surface layer and a loamy subsoil. These soils are on nearly level to sloping uplands. They are in the west-central, central, and southern parts of the county.

The surface layer is brown or dark grayish-brown, slightly acid loamy fine sand (fig. 5). This layer is about 6 inches thick and is easy to till.

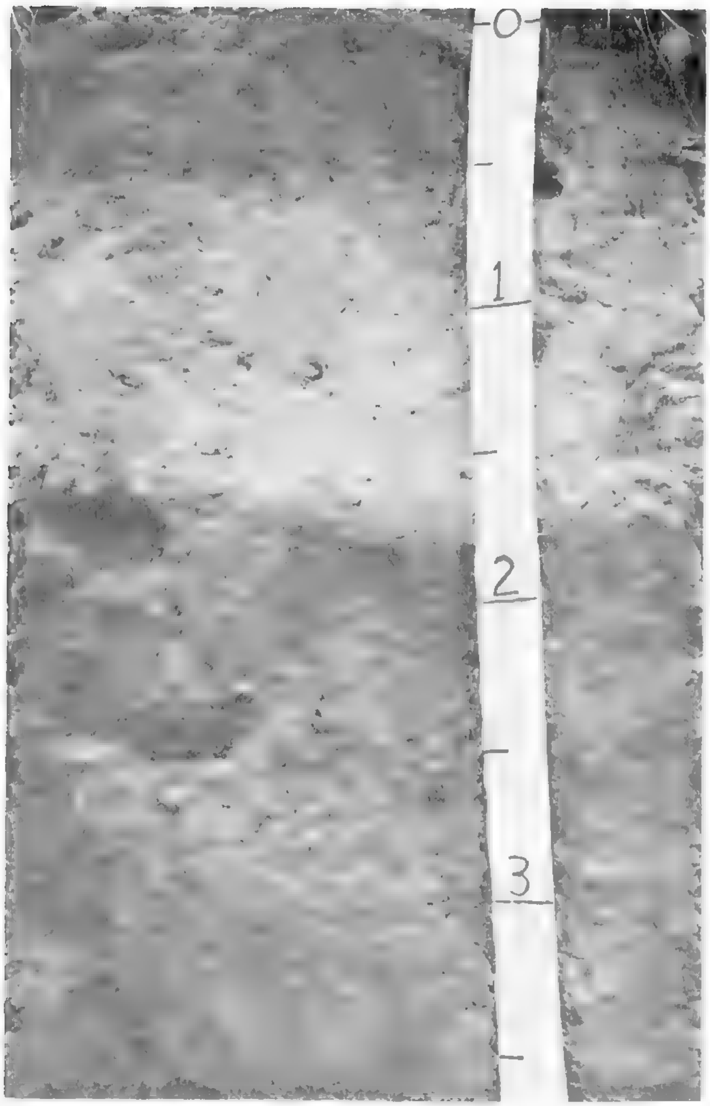

Figure 5.—Profile of Konawa loamy fine sand.

The upper part of the subsoil is red or yellowish-red, medium acid sandy clay loam of massive structure. The lower part is similar except that it contains less clay. The total thickness of the subsoil is about 48 inches.

The underlying material is deep, loose, medium acid loamy fine sand. This material, which has been partially reworked by wind, is easy for plant roots to penetrate.

Konawa soils are somewhat excessively drained. Internal drainage is rapid, and permeability is moderate. The ability of Konawa soils to absorb and retain moisture is low. These soils have low natural fertility, and they are susceptible to wind and water erosion.

About one-fourth of the acreage of Konawa soils is cultivated. These soils are suited to small grains, grain sorghums, cotton, legumes, and grass. Winter wheat is the crop most widely grown.

Konawa loamy fine sand, undulating (KoB).—This is a sandy soil of the uplands in the central and the southeastern parts of the county. It is associated with Konawa loamy fine sand, hummocky, and Shellabarger fine sandy loam, 0 to 3 percent slopes.

Included in mapping of this soil were small areas of Konawa loamy fine sand, hummocky, and of Shellabarger fine sandy loam, 0 to 3 percent slopes, that total 5 to 8 percent of individual areas.

Most areas of this soil are cultivated. Winter wheat is the principal crop. Cotton, grain sorghums, and legumes are also grown.

This soil requires a cropping system that provides for cover against wind erosion during winter and spring. Good farming practices, including minimum tillage, stripcropping, and planting of legumes in the crop rotation, are also necessary. (Capability unit IIIe-3; Deep Sand Savannah range site; woodland suitability group 2)

Konawa loamy fine sand, hummocky (KoC).—Much of this soil is on large ridges or on low, rounded sandy rises that are either within undulating areas or bordering them.

Included with this soil in mapping were small areas of Nobscot fine sand, hummocky, that total 8 to 10 percent of individual areas.

This soil is not a desirable one for farming. It is suited to permanent grass for pasture. The most productive grasses are sand bluestem, little bluestem, and switchgrass.

Unless well protected, this hummocky soil is susceptible to severe wind erosion when tilled. The low inherent fertility, sandy texture, and low water-holding capacity limit its suitability for cultivated crops. (Capability unit IVe-3; Deep Sand Savannah range site; woodland suitability group 2)

Lela Series

The Lela series consists of dark-colored, nearly level soils on clayey alluvium. These soils are on parts of the flood plains of the North and South Canadian Rivers.

The surface layer is dark-gray or very dark grayish-brown, calcareous clay. This layer is of moderate, fine, granular structure, is about 24 inches thick, and is very difficult to till.

The subsoil is gray or very dark gray, calcareous clay. This layer is of weak, medium, blocky structure and is about 12 inches thick. The water table fluctuates at depths between 30 and 34 inches, the actual depth depending on the amount of flooding or rainfall.

The underlying material is calcareous, fine-textured alluvium that is difficult for plant roots to penetrate.

Lela soils are somewhat poorly drained and are occasionally flooded. Internal drainage is slow, and permeability is very slow. The ability of Lela soils to absorb and retain moisture is high. These soils have moderately high natural fertility.

About half of the acreage of Lela soils is cultivated; the rest is in native grass. These soils are suited to small grains, grain sorghums, cotton, and grass. Winter wheat is the crop most widely grown.

Lela clay, wet (Lc).—This soil is on nearly level flood plains near the North Canadian River. It has the profile described as typical of the series. It is associated with Lela, wet-Slickspots complex and Leshara-Slickspots complex.

Included with this soil in mapping were small areas of Lela, wet-Slickspots complex and of Leshara-Slickspots complex, each of which cover 3 to 4 percent of the total acreage.

About half of this soil is cultivated; the rest is in native grass. This soil is difficult to till and because of its texture, fluctutating water table, and saline or alkaline spots, it is not well suited to cultivation. It is well suited to native grass. (Capability unit IVw-1; Subirrigated range site; woodland suitability group 4)

Lela, wet-Slickspots complex (Le).—This complex consists of Lela clay, wet, and slickspots. The Lela clay covers about 70 to 90 percent of the acreage, and the slickspots about 10 to 30 percent. This mapping unit is in nearly level to slightly concave areas on the flood plain of the North Canadian River. These soils are calcareous to the surface or to within 20 inches of the surface.

The surface layer of the slickspots is clay. A hard, glazed, whitish crust, about 1/4 to 1 inch thick, forms on the surface soil when it drys after a rain. Just below the crust the dry colors range from gray to dark gray, but at lower depth they grade from light gray to reddish brown.

The subsoil and substratum are mostly clays that are weakly stratified with clay loam to sandy loam materials. The depth to the water table ranges from 24 to 48 inches.

Similar methods of tillage and soil management are applied to all of this complex. About 50 percent of this soil is cultivated to small grains, sorghum, and cotton. The nontilled land is in native grass. The crop yield in areas of slickspots averages about half the yield in areas of Lela clay, wet. The slickspots can be treated by applying a mulch composed of 3 to 4 tons per acre of organic material, such as cotton burs, straw, or hay, and 20 pounds of nitrogen per ton of mulch. A second practice, though it impedes cultivation of these areas for 2 years, is to apply 3 to 5 tons per acre of finely ground, nearly pure gypsum. (Capability unit IVw-2; Lela, wet, in Subirrigated range site, and Slickspots in Alkali Bottom Land range site; woodland suitability group 4)

Leshara Series

The Leshara series consists of deep, dark-colored soils that formed in nearly level, mixed sandy and loamy alluvium. These soils are in the valleys along the North and South Canadian Rivers.

The surface layer is grayish-brown to very dark grayish-brown calcareous fine sandy loam. This layer is of moderate, fine, granular structure, is about 10 inches thick, and is easy to till.

The subsoil is brown to dark-gray, calcareous loam to silt loam or light silty clay loam. This layer is of moderate, medium, granular structure and is about 22 inches thick. The water table fluctuates at depths of 36 to 46 inches, the actual depth depending on the amount of flooding or rainfall.

The underlying material is friable, calcareous, sandy alluvium that is easy for plant roots to penetrate.

Leshara soils are somewhat poorly drained. Internal drainage is medium, and permeability is moderate. The ability of Leshara soils to absorb and retain moisture is moderate. These soils have medium natural fertility. When tilled, they are susceptible to wind erosion. They also are flooded occasionally.

Most areas of Leshara soils are cultivated. They are suited to small grains, grain sorghums, cotton, and grass. Winter wheat is the crop most widely grown.

Leshara-Slickspots complex (Lh).—This complex is 70 to 90 percent Leshara soils and 10 to 30 percent slickspots.

The slickspots are in irregularly shaped shallow swales 1/10 acre to 1 acre in size. These areas have a loam to clay loam surface layer on which a hard, glazed, whitish crust forms after a rain. This crust is 1/4 to 1/2 inch thick. The slickspots are calcareous throughout. The substratum is sandy in most places. The water table is 30 to 45 inches below the surface.

The slickspots can be treated by applying a mulch consisting of 3 to 4 tons per acre of organic material, such as cotton burs, straw, or hay, and 20 pounds of nitrogen per ton of mulch. A second practice, which impedes cultivation of these areas for 2 years, is application of 3 to 5 tons per acre of finely ground, nearly pure gypsum.

Tillage and soil management are similar for all areas of this complex. Crop yields on the slickspots average about half the yield on the Leshara soils. About 75 percent of this complex is cultivated, and winter wheat is the principal crop. The rest of the complex is in native grass. (Capability unit IVw-2; Leshara soils in Loamy Bottom Land range site, and Slickspots in Alkali Bottom Land range site; woodland suitability group 3)

Lincoln Series

The Lincoln series consists of nearly level brown soils on mixed sandy and loamy alluvium. They are on the flood plains of the North and South Canadian Rivers.

The surface layer is brown, calcareous loamy fine sand of granular structure. This layer is about 12 inches thick, and it is easy to till.

Beneath this is a pale-brown to brown, calcareous loamy sand layer that is stratified and about 6 inches thick.

The underlying material, consisting of calcareous sandy alluvium, is also stratified. It is easy for plant roots to penetrate.

Lincoln soils are well drained. Internal drainage and permeability are rapid. The ability of Lincoln soils to absorb and retain moisture is low. They have low natural fertility and are occasionally flooded.

Most areas of Lincoln soils are in native grass.

Lincoln loamy fine sand (Ln).—This soil is on nearly level flood plains in close association with the Wann and Leshara soils. Included with it in mapping were small areas of Wann soils totaling about 6 to 8 percent of the acreage, and areas of Leshara-Slickspots complex covering about 2 to 3 percent.

Less than one-fourth of this soil is now cultivated. It is better suited to grass. Because this soil remains wet for long periods after heavy rains or floods, the choice of crops is limited.

The practices of management needed are those that maintain fertility and control erosion. Among these are conserving crop residues, stubble mulching, planting of cover crops, and applying fertilizer or using a cropping system that includes legumes. (Capability unit IIIe-6; Sandy Bottom Land range site; woodland suitability group 1)

Lucien Series

The Lucien series consists of shallow, loamy soils, mostly on strongly sloping uplands. These soils are in the western and southwestern parts of the county.

The surface layer is reddish-brown, neutral fine sandy loam of granular structure. This layer is about 10 inches thick. The subsoil is red, very friable fine sandy loam.

The underlying material is weakly consolidated sandstone. It is soft and in places is calcareous along joints and bedding planes. Plant roots easily penetrate the upper parts of the sandstone, but at lower depths they enter only by following along the joints and fractures in the rock.

Lucien soils are somewhat excessively drained. Internal drainage is rapid, and permeability is moderately rapid. The ability of Lucien soils to absorb and retain moisture is low. These soils have low natural fertility and are very susceptible to water erosion when improperly managed.

Many areas of Lucien soils in native woods and grasses are used for grazing. These soils are not suited to cultivation.

Lucien-Rock outcrop complex (Lr).—This land type consists mainly of Lucien soils and small areas of Rock outcrop. In this complex are steep, broken drainageways and canyons and, where geologic erosion is active, shallow soils derived from red sandstone. Slopes range from 5 to 20 percent.

About 10 to 15 percent of this mapping unit consists of rock outcrops that contain soft, red sandstone and some dolomite.

This land is suited to native grass, and it provides a habitat for wildlife. (Capability unit VIIs-1; Breaks range site; woodland suitability group 4)

McLain Series

The McLain series consists of deep nearly level soils. These soils formed in broad areas of alluvium near the North Canadian River and in large stream valleys in the northeastern part of the county.

The surface layer is dark-brown or dark grayish-brown, neutral silty clay loam. This layer is of granular structure, is moderately difficult to till, and is about 12 inches thick.

The upper part of the subsoil is reddish-brown silty clay loam or light clay of moderate, medium, subangular blocky structure. The lower part is similar, but redder. The total thickness of the subsoil is about 20 inches.

The underlying material is firm, neutral to calcareous silty alluvium that is moderately difficult for plant roots to penetrate.

McLain soils are naturally well drained. Internal drainage is medium, and permeability is moderately slow. The ability of McLain soils to absorb and retain moisture is high, and the soils have high natural fertility.

Most areas of McLain soils are cultivated. They are suited to small grains, sorghums, alfalfa, and native grass. Winter wheat is the crop most widely grown.

McLain silty clay loam (Mc).—This nearly level soil formed in alluvium, and it is in association with the Port and Dale soils. Included with it in mapping were small areas of Port clay loam that total about 5 percent of the acreage and of Dale silt loam that also total about 5 percent.

All of this soil is cultivated, except a few small areas in native grass. This is one of the more desirable soils in the county for small grains. Winter wheat is the principal crop.

Maintaining soil fertility and structure by crop rotation and proper tillage is necessary. The soil should not be plowed when wet, nor tilled excessively. Stubble mulching and using crop residue are ways of improving tilth. (Capability unit I-1; Loamy Bottom Land range site; woodland suitability group 1)

Miles Series

In the Miles series are deep, dark-colored, very gently sloping to gently sloping loamy soils of the uplands. They are mostly in the west-central part of the county.

The surface layer is brown or dark-brown, neutral fine sandy loam. This layer is of weak granular structure, is about 12 inches thick, and is easy to till. The depth of this layer varies according to the degree of slope and amount of erosion.

The subsoil contains more clay in the middle part than in the upper or lower parts. The upper part is reddish-brown or brown, neutral light sandy clay loam that has weak, fine, subangular blocky structure. The middle part is neutral, reddish-brown or brown clay loam of moderate, medium, subangular blocky structure. The lower part is yellowish-red to red, neutral light sandy clay loam that has weak, fine, subangular blocky structure. The total thickness of the subsoil is about 50 inches.

The underlying material consists of friable, neutral, deep light sandy clay loams to loamy sands that are easy for plant roots to penetrate.

Miles soils are naturally well drained. Internal drainage is medium, and permeability is moderate. The ability of Miles soils to absorb and retain soil moisture is moderate. These soils have medium to high natural fertility, but they are susceptible to soil blowing and water erosion.

Most areas of Miles soils are cultivated. They are suited to small grains, grain sorghums, cotton, and native grass. Winter wheat is the crop most widely grown.

Miles fine sandy loam, 1 to 3 percent slopes (MlB).—This very gently sloping soil is a desirable one for farming. It has the profile described as typical of the series. Included with this soil in mapping were small areas of Dill and Nobscot soils.

All of this soil is cultivated except a few small areas in native grass. Winter wheat is the principal crop.

Among the needed management practices are stubble mulching, leaving crop residue on the surface soil, and rotating crops with grasses or legumes. Using crop residue helps control soil blowing, and terracing and contour farming help to control water erosion. Excessive tillage should be avoided. (Capability unit IIe-2; Sandy Prairie range site; woodland suitability group 1)

Miles fine sandy loam, 3 to 5 percent slopes (MlC).—This is a gently sloping soil of the sandy uplands. It is associated with very gently and gently sloping Dill and Nobscot soils. Included with this soil in mapping were small areas of Dill and Nobscot soils.

This soil requires protection from soil blowing, control of runoff, and maintenance of fertility and structure. Crop residues and cover crops can be used to curb soil blowing, contour farming and terracing to control runoff, and fertilizer or legumes in the cropping system to maintain soil fertility. Avoiding excessive tillage helps to maintain soil structure. (Capability unit IIIe-2; Sandy Prairie range site; woodland suitability group 2)

Minco Series

The Minco series consists of deep, dark-colored loamy soils of the uplands. These nearly level to steep soils are in the southern part of the county.

The surface layer is dark-brown, neutral loam of granular structure. It is about 24 inches thick and is easy to till.

The subsoil is a dark-brown, neutral loam of weak, fine, granular structure. It is about 26 inches thick.

The underlying material consists of friable, calcareous, loamy material that is easily penetrated by roots.

Minco soils are naturally well drained. Internal drainage is medium, and permeability is moderate to moderately rapid. These soils absorb and retain moisture moderately well. They are medium to high in natural fertility but are susceptible to soil blowing and water erosion when tilled.

Most areas of Minco soils are cultivated. Suitable crops are small grains, grain sorghums, cotton, legumes, and native grass. Winter wheat is the crop most widely grown.

Minco loam, 0 to 1 percent slopes (MnA).—This soil is one of the most desirable in the county for farming. It has the profile described as typical of the series. Included with this soil in mapping were small areas of Vanoss loam, 0 to 1 percent slopes, that total about 3 to 5 percent of the acreage, and of Minco very fine sandy loam that cover about 3 percent.

Most areas of this soil are cultivated to small grains, grain sorghums, cotton, and legumes. Only a few small areas are in grass.

Crop residues are needed on this soil to protect it against soil blowing. Soil structure and fertility can be improved by adding fertilizer and by providing grasses or legumes in the cropping system. (Capability unit I-2; Loamy Prairie range site; woodland suitability group 1)

Minco loam, 1 to 3 percent slopes (MnB).—This very gently sloping soil of the uplands is associated with nearly level Minco and Vanoss soils. It is in the southwestern part of the county.

Included with this soil in mapping were areas of Vanoss loam, 1 to 3 percent slopes, that occupy about 5 percent of the acreage, and of Minco very fine sandy loam, 3 to 8 percent slopes, that cover about 2 percent.

The surface layer of this soil has been thinned by erosion in some places, or never was quite so thick as the one described for the series. In most places the surface layer is brown or dark-brown loam, but in some small areas it is very fine sandy loam. This layer ranges from 18 to 30 inches in thickness.

The subsoil is fine sandy loam to loam that is brown or dark brown in the upper part and reddish brown to brown in the lower part.

Most areas of this soil are cultivated. Winter wheat is the principal crop.

In managing these soils, the main concerns are maintaining or improving fertility and providing protection against water erosion and soil blowing. Suitable practices are terracing, contour farming combined with a crop rotation, management of crop residue, and minimum tillage. (Capability unit IIe-1; Loamy Prairie range site; woodland suitability group 1)

Minco loam, 3 to 5 percent slopes (MnC).—This soil is on gently sloping uplands in the southwestern part of the county. It is associated with Minco loam, 1 to 3 percent slopes, and Minco very fine sandy loam, 3 to 8 percent slopes.

Included with this soil in mapping were areas of Minco very fine sandy loam, 3 to 8 percent slopes, that total about 10 percent of the acreage.

The surface layer of this soil has been thinned by erosion, or it was never quite so thick as the one described for the series. The surface layer is brown or dark brown and 18 to 24 inches thick.

The upper subsoil is brown or dark-brown fine sandy loam to loam, and the lower subsoil is reddish-brown to brown fine sandy loam to loam.

Like Minco loam, 1 to 3 percent slopes, this soil is subject to water erosion and soil blowing, and its fertility and structure should be maintained or improved. The cropping system used allows less time for cotton, sorghums, and other soil-depleting crops than can be allowed on the less sloping Minco loams. (Capability unit IIIe-1; Loamy Prairie range site; woodland suitability group 2)

Minco very fine sandy loam, 3 to 8 percent slopes (MoD).—This soil is on gently sloping and sloping uplands, mostly in the southwestern part of the county. It is associated with Minco loam, 3 to 5 percent slopes, and Minco very fine sandy loam, steep. This soil is more sandy and contains less silt than Minco loam.

Included with this soil in mapping were areas of Minco very fine sandy loam, steep, that total about 5 to 6 percent of the acreage.

This soil is not well suited to cultivation, because it is moderately steep, susceptible to soil blowing and water erosion, and low in fertility. (Capability unit IVe-2; Loamy Prairie range site; woodland suitability group 3)

Minco very fine sandy loam, steep (MoE).—This soil forms part of the bluffs facing both sides of the South Canadian River. It is also alongside a few of the larger streams that drain into this river. Where gullying is

deep, erosion is active on the slopes. Slopes range from 8 to 20 percent.

The surface layer is mostly a brown or dark-brown very fine sandy loam, but in small areas it is fine sandy loam. It ranges from a few inches to 30 inches in thickness, the actual thickness depending on position and slope.

In places this soil supports a good stand of native grasses. The principal ones are little bluestem, sand bluestem, and blue grama. (Capability unit VIe-5; Loamy Prairie range site; woodland suitability group 4)

Nobscot Series

The Nobscot series consists of deep, timbered sandy soils on very gently sloping to moderately steep uplands. These soils lie diagonally across the county from northwest to southeast.

The surface layer is brown or dark grayish-brown, slightly acid fine sand. This structureless layer is about 4 inches thick and is easily tilled. The subsurface layer is pale-brown or yellowish-brown, medium acid, loose sand about 18 inches thick.

The subsoil is a yellowish-red, medium acid sandy loam that has bands of dark reddish brown and yellowish-red or red sandy loam to light clay loam. These bands are about 2 inches thick. This layer is of granular structure and is about 10 inches thick.

The underlying material is loose, medium acid, deep loamy sand. This material has been partially reworked by wind and is easily penetrated by plant roots.

Nobscot soils are somewhat excessively drained. Internal drainage is rapid, and permeability is moderately rapid. The ability of these soils to absorb and retain moisture is low. Nobscot soils have low natural fertility and are more susceptible to soil blowing than to water erosion.

About one-fourth of the acreage in Nobscot soils is cultivated. These soils are suited to cotton and cowpeas. Sorghum is the crop most widely grown.

Nobscot fine sand, undulating (NcB).—This soil is mostly in the central and west-central parts of the county and ranges in slope from 0 to 3 percent. It is closely associated with Nobscot fine sand, hummocky, Pratt loamy fine sand, undulating, Shellabarger fine sandy loam, 0 to 3 percent slopes, and Miles fine sandy loam, 1 to 3 percent slopes.

Included with this soil in mapping were a few small areas of Pratt loamy fine sand, undulating, that total about 5 percent of the acreage.

The surface layer of this Nobscot soil is slightly thicker than that described for the series, and the subsurface layer is thinner.

About half of this soil is cultivated to sorghums and cotton; the rest is in native grass. This soil is not well suited to cultivation, because it is sandy, low in fertility, and subject to moderate or severe wind erosion when tilled. The hazard of wind erosion can be reduced by using crop residue and by planting wheat and other close-growing crops. (Capability unit IVe-7; Deep Sand Savannah range site; woodland suitability group 2)

Nobscot fine sand, hummocky (NcC).—This is a sandy soil of the uplands that is in close association with Nobscot fine sand, undulating, and Konawa loamy fine sand, hummocky. The profile is that described as typical of the series. Most of this soil is on large ridges or on low, rounded sandy rises within or bordering undulating areas. Slopes range from 3 to 8 percent.

Included with this soil in mapping were small areas of Pratt loamy fine sand, hummocky, and of Konawa loamy fine sand, hummocky. Each included soil totals about 4 to 5 percent of the acreage.

Nearly all of the acreage is in native grass. This soil supports a dense stand of blackjack trees and a sparse stand of tall grasses. Proper range management increases the stand of grasses and materially decreases the stand of blackjack trees. Areas that are tilled should be reseeded to native grasses. (Capability unit IVe-7; Deep Sand Savannah range site; woodland suitability group 2)

Nobscot fine sand, rolling (NcD).—This sandy soil is on large, rolling hills in close association with Nobscot fine sand, hummocky. Slopes range from 5 to 20 percent.

The surface layer is thinner than that described for the series. The subsurface layer is thicker, or 20 to 30 inches in thickness.

This soil supports a thick stand of blackjack and post oaks and a thin stand of mixed tall grasses. The most productive grasses are sand bluestem, little bluestem, and switchgrass. These and other grasses can be increased by proper range use. (Capability unit VIe-4; Deep Sand Savannah range site; woodland suitability group 2)

Norge Series

The Norge series consists of deep, dark-colored loamy soils on nearly level to sloping uplands. These soils are in the northeastern part of the county.

The surface layer is brown or dark-brown slightly acid loam. This layer is of granular structure, is about 12 inches thick, and is easy to till.

The subsoil is about 48 inches thick. It contains less clay and is more friable in its upper part than in its lower. The upper part of the subsoil is a reddish-brown clay loam or light clay loam of fine, subangular, blocky structure. The lower part is reddish-brown or red, limy heavy clay loam to light clay loam of moderate, medium, subangular blocky structure.

The underlying material is loamy, silty, calcareous, and moderately difficult for plant roots to penetrate.

Norge soils are naturally well drained. Internal drainage is medium, and permeability is moderately slow. The ability of these soils to absorb and retain moisture is moderate. These soils have high natural fertility, but they are susceptible to soil blowing and water erosion when tilled.

Most areas of Norge soils are cultivated. They are suited to small grains, sorghums, cotton, legumes, and grass. Winter wheat is the crop most widely grown.

Norge loam, 0 to 1 percent slopes (NoA).—This soil is nearly level. It has the profile described as typical of the series. Included with this soil in mapping were small areas of Shellabarger fine sandy loam, 0 to 3 percent slopes, that total 5 to 7 percent of the acreage, and of Bethany silt loam, 0 to 1 percent slopes, that cover about 2 percent.

This is a desirable soil for farming. Much of it is cultivated; only a few small areas are in native grass. Winter wheat is the principal crop.

Maintenance of soil structure and fertility are needed to produce optimum yields. Cotton, row sorghums, and other soil-depleting crops should not be grown for more than 6 consecutive years. (Capability unit I–2; Loamy Prairie range site; woodland suitability group 2)

Norge loam, 1 to 3 percent slopes (NoB).—This soil is on very gently sloping uplands, mostly in the east-central part of the county. It is associated with nearly level Norge loam, Bethany and Kirkland silt loams, and the Renfrow silty clay loams on 1 to 3 percent slopes.

Included with this soil in mapping were small areas of Shellabarger fine sandy loam, 0 to 3 percent slopes, that total about 5 to 7 percent, and of Renfrow silty clay loam, 1 to 3 percent slopes, that cover about 2 percent. Slickspots are also included. They are shown on the soil map by the symbol for gumbo or scabby spots. These areas are too small to be delineated as Norge-Slickspots complex, 0 to 3 percent slopes.

The surface layer of this soil has been thinned by erosion in places, or it was never quite so thick as the one described for the series. The surface layer is mostly a brown to dark-brown loam, though in small areas it is fine sandy loam. The upper part of the subsoil is a reddish-brown clay loam or light clay loam, and the lower part is reddish-brown or red light clay loam.

Most areas of this soil are cultivated. Winter wheat is the principal crop.

This soil requires protection from water erosion and maintenance of fertility and structure. Terracing, used with contour farming and a planned cropping system, minimizes the loss of soil from cultivated fields and helps to maintain the fertility and tilth of the soil. (Capability unit IIe–3; Loamy Prairie range site; woodland suitability group 2)

Norge loam, 3 to 5 percent slopes (NoC).—This soil is on gently sloping, eroded uplands. It is in the east-central part of the county and is associated with gently sloping Norge loam and Shellabarger fine sandy loam.

Included with this soil in mapping were small areas of Shellabarger fine sandy loam, 3 to 5 percent slopes, that total 5 to 8 percent of individual areas. Also included were isolated slickspots.

The surface layer has been thinned by erosion in some places, or it was never quite so thick as that in the series description. In other places there are several small rills where surface runoff accumulates. Proper management would have helped to protect these areas from slight to moderate erosion. In cultivated fields, 5 to 10 percent of the acreage has been eroded so much that subsequent plowing has mixed the original surface soil and the upper part of the subsoil. In most places, the surface layer is brown to dark-brown loam, but it includes some areas of fine sandy loam. It ranges from 6 to 10 inches in thickness.

Most areas of this soil are cultivated. Winter wheat is the principal crop. On this soil practices are needed that control water erosion and maintain fertility and structure. Among these practices are use of crop residue, legumes, or fertilizer and contour farming and terracing. (Capability unit IIIe–1; Loamy Prairie range site; woodland suitability group 2)

Norge loam, 5 to 8 percent slopes (NoD).—This soil is on sloping, eroded uplands in the east-central part of the county. Much of it is on short side slopes or other small, irregularly shaped, moderately steep areas.

Included with this soil in mapping were small areas of Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes, that total 3 to 4 percent of individual areas. Also included were isolated slickspots, which are shown on the map sheets by the symbol for gumbo or scabby spots.

In some places the surface layer has been thinned by erosion. Slight to moderate erosion has occurred in some plowed areas because proper management has been lacking. In these fields 10 to 20 percent of the acreage has a plow layer that is a mixture of the original surface soil and part of the subsoil. The surface layer is mostly brown to dark-brown loam, but it includes some areas of fine sandy loam. This layer ranges from 6 to 10 inches in thickness. The subsoil is red.

Most areas of this soil are cultivated. Winter wheat is the principal crop. This soil requires protection from water erosion and maintenance of soil structure. Erosion can be controlled by using terraces and contour farming and by including sown crops in the cropping system each year. Soil fertility and tilth are maintained by using crop residue effectively, or by seeding legumes or by adding fertilizer. (Capability unit IVe–2; Loamy Prairie range site; woodland suitability group 3)

Norge-Slickspots complex, 0 to 3 percent slopes (NsA).—About 65 to 85 percent of this complex is made up of Norge loam, 10 to 25 percent of slickspots, and 10 to 25 percent of soils that intergrade from Norge loam to slickspots.

Included with this complex in mapping were small areas of Shellabarger fine sandy loam and Kingfisher silt loam that total 5 percent of individual areas. Also included were isolated slickspots.

The surface layer of the slickspots is grayish-brown to yellowish-brown, calcareous or noncalcareous loam to clay loam that ranges from 2 to 10 inches in thickness. This layer overlies weak, blocky to massive clay loam to clay. Where slickspots are abundant, the surface layer is saline, alkaline, or both. Where slickspots are fewer, the surface layer is generally neither saline nor alkaline, but at some depth the soil material is saline, alkaline, or both. When the slickspots dry after a rain, a hard, glazed, whitish crust, 1/4 to 1 inch thick, forms at the surface. Slickspots are nearly circular to irregular in shape, and each covers an area of 1/4 acre to 3 acres.

The surface layer of the intergrading soil is loam to clay loam 10 to 15 inches thick. An abrupt or gradual boundary separates the surface layer from the subsoil. The subsoil is clay that is massive or has weak blocky structure. Unlike the slickspots, this intergrading soil does not crust at the surface, but its subsoil is harder and more compact than that of Norge loam.

Most areas of Norge-Slickspots complex, 0 to 3 percent slopes, are cultivated. Winter wheat is the principal crop. Crop yields are favorable on the Norge soils, but they are poor on the slickspots because of the crust that forms at the surface. Yields can be increased on the slickspots if 3 to 5 tons of gypsum per acre are applied and if cultivation is delayed for at least 2 years. (Capability unit IIIs–1; Norge soils in the Loamy Prairie range site, and the slickspots in the Slickspot range site; woodland suitability group 3)

Port Series

In the Port series are deep loamy soils. These nearly level soils are in the northeastern part of the county on flood plains, but they are above the level that ordinarily is flooded.

The surface layer is reddish-brown or dark-brown, calcareous loam or clay loam of granular structure. This layer is about 10 inches thick and is easy to moderately difficult to till.

The subsoil contains more clay and is more compact in the lower part than in the upper. The upper part is red to dark-red clay loam or silty clay loam of moderate, medium, granular structure. The lower part is red, calcareous light clay loam of weak, fine, granular structure. The total thickness of the subsoil is about 40 inches.

The underlying material is friable loamy alluvium that is moderately difficult for plant roots to penetrate.

Port soils are naturally well drained. Internal drainage is medium, and permeability is moderately slow. The ability of these soils to absorb and retain soil moisture is moderate. Natural fertility is high.

Most areas of Port soils are cultivated. Suitable crops are small grains, grain sorghums, cotton, alfalfa, and grass. Winter wheat is the crop most widely grown.

Port clay loam (Pc).—This nearly level soil lies along streams. It has a profile like that described for the series. It is associated with Port loam and McLain silty clay loam.

Included with this soil in mapping were small areas of Port loam that border creeks and total about 5 percent of the acreage. Also included were areas of McLain silty clay loam that also total about 5 percent.

Except for a few small areas in native grass, all of this soil is cultivated. Winter wheat is the principal crop.

This is one of the most desirable soils in the county for farming, but management is needed that maintains soil structure and fertility. This management is provided by a cropping system that includes the seeding of legumes and adding fertilizer. (Capability unit IIw-3; Loamy Bottom Land range site; woodland suitability group 1)

Port loam (Po).—This nearly level soil borders some of the larger streams in the county. It has a profile like that described for the series. It is associated with Port clay loam and Yahola loam.

Included with this soil in mapping were small areas of Yahola loam that border stream channels and total about 5 percent of the acreage. Also included and totaling about 5 percent of the acreage are small areas of Port clay loam.

Almost all of this soil is cultivated, but a few small areas are in native grass. Winter wheat is the principal crop. Management is needed that maintains soil structure and fertility. This can be done by using a cropping system that provides for proper tillage and the seeding of legumes, and the adding of fertilizer. (Capability unit IIw-3; Loamy Bottom Land range site; woodland suitability group 1)

Pratt Series

The Pratt series consists of deep, dark-colored, nearly level to sloping sandy soils of the uplands. These soils are in the northwestern part of the county.

The surface layer is dark-brown or dark grayish-brown, neutral loamy fine sand. This layer is easily tilled and about 10 inches thick.

The subsoil, about 8 inches thick, is dark-brown or yellowish-brown, neutral fine sandy loam of weak, very fine, granular structure.

The underlying material is deep, loose, neutral loamy fine sand that has been partially reworked by wind and is very easily penetrated by plant roots.

Pratt soils are somewhat excessively drained. Internal drainage is rapid, and permeability is moderately rapid. These soils have little capacity to absorb and retain moisture. They are low in natural fertility and are more susceptible to soil blowing than to water erosion.

About half of the acreage of Pratt soils is cultivated. Suitable crops are small grains, sorghums, cotton, cowpeas, and grass. Winter wheat is the crop most widely grown.

Pratt loamy fine sand, undulating (PrB).—This soil is in the sandy uplands and has slopes of 0 to 3 percent. It is associated with Nobscot fine sand, undulating, and Carwile-Shellabarger complex, 0 to 2 percent slopes. This soil has the profile described as typical of the series.

Included with this soil in mapping were about 500 acres of Pratt loamy fine sand, undulating, that have a reddish rather than dark-brown or yellowish-brown subsoil. The 500 acres are in two areas, one east of Hitchcock, along Cooper Creek, and the other in the southwestern part of the county, north of Deer Creek. Also included in mapping were 500 acres in a mixed pattern about 5 miles southeast of Okeene, between Spring Creek and Salt Creek. In this pattern were undulating Pratt loamy fine sand that has a reddish subsoil and a soil that has a loamy fine sand surface layer, 8 to 12 inches thick, and a reddish clay loam subsoil. Also included were small areas of the Carwile-Shellabarger complex, 0 to 2 percent slopes, that total 4 or 5 percent of the acreage, and small areas of Nobscot fine sand, undulating, that cover 2 or 3 percent.

Much of this soil is cultivated, and the rest is in native grass. This soil is easy to till and is suited to many kinds of crops. Management is needed that controls soil blowing and water erosion and maintains fertility. This management includes minimum tillage, stripcropping, and the planting of legumes in the crop rotation. (Capability unit IIIe-3; Deep Sand range site; woodland suitability group 2)

Pratt loamy fine sand, hummocky (PrC).—This sandy soil of the uplands has slopes of 3 to 8 percent. It is closely associated with Pratt loamy fine sand, undulating, and with Nobscot fine sand, hummocky. Except that the surface layer is generally thinner, the profile of this soil is like the one described for the Pratt series. In some tilled areas, the surface layer is 6 to 10 inches thick.

Included with this soil in mapping, in the extreme southwestern part of the county, were small areas of a hummocky Pratt loamy fine sand that has a reddish

subsoil. These included areas make up about 5 percent of the mapped areas. Also included, and making up about 5 percent of the mapped areas, were small areas of Carwile-Shellabarger complex, 0 to 2 percent slopes.

Most of this soil is in native grass, but some is cultivated. Crop yields are low. Cultivated areas are susceptible to moderate and severe soil blowing because the surface layer is sandy and slopes are uneven. (Capability unit IVe-7; Deep Sand range site; woodland suitability group 3)

Quinlan Series

The Quinlan series consists of shallow loamy soils, mostly on strongly sloping uplands. These soils are in the western and southwestern parts of the county.

The surface layer is yellowish-red, calcareous loam. This layer is of weak, fine, granular structure and is about 10 inches thick.

The underlying material is weakly consolidated, calcareous sandstone. Plant roots easily penetrate the upper part of this material, but lower down they can only follow the bedding planes, joints, and fractures in the sandstone.

Quinlan soils are somewhat excessively drained. Internal drainage is rapid, and permeability is moderately rapid. These soils have little ability to absorb and retain moisture. They are low in natural fertility and are susceptible to water erosion if not managed properly.

Most areas of Quinlan soils are unsuitable for cultivation. Nearly all of the acreage is in grass.

Quinlan-Woodward loams, 5 to 20 percent slopes (QwF).—This complex is along broken drainageways and canyons. It consists mainly of Quinlan and Woodward soils and outcrops of soft, red, weakly calcareous sandstone in small areas. The Quinlan soils account for about 60 percent of the complex, and the Woodward soils, most of the rest. These soils have profiles similar to the ones described for their respective series.

These soils are used for native grass, wildlife habitat, and recreation. The principal grasses are little bluestem, sand bluestem, and sideoats grama. Ponds can be developed at the sites of springs and in other desirable places. (Capability unit VIe-6; Quinlan soils in Shallow Prairie range site, and Woodward soils in Loamy Prairie range site; woodland suitability group 4)

Reinach Series

The Reinach series consists of deep, nearly level loamy soils on low terraces along the South Canadian River.

The surface layer is reddish-brown, brown, or dark-brown, moderately alkaline very fine sandy loam. It is of granular structure, is easily tilled, and is about 14 inches thick.

The subsoil contains a little less clay in the lower part than in the upper. The upper part is a yellowish-red very fine sandy loam of weak, fine, granular structure. The lower part is yellowish-red, calcareous fine sandy loam of weak, fine, granular structure. The total thickness of the subsoil is about 26 inches.

The underlying material is loamy alluvium that is very friable, calcareous, and easily penetrated by plant roots.

Reinach soils are naturally well drained. Internal drainage is medium, and permeability is moderate. The ability of these soils to absorb and retain moisture is moderate. Natural fertility is high. Tilled fields are subject to slight soil blowing.

Most areas of Reinach soils are cultivated. These soils are suited to small grains, grain sorghums, cotton, alfalfa, and grass. Winter wheat is the crop most widely grown.

Reinach very fine sandy loam (Ra).—This nearly level soil is along streams. It is associated with Canadian and Yahola soils. Included with it in mapping were small, lower areas of Yahola loam that total 3 to 4 percent, and small areas of Canadian fine sandy loam that cover 4 to 6 percent.

This is one of the most desirable soils for farming in the county. Except for a few small areas in native grass, all of it is cultivated. It is suited to small grains, grain sorghums, cotton, and alfalfa. Management is needed that maintains soil fertility and structure. A soil-improving crop rotation and proper tillage are effective. (Capability unit I-1; Loamy Bottom Land range site; woodland suitability group 1)

Renfrow Series

The Renfrow series consists of deep, nearly level to gently sloping soils of the uplands. These soils are in the northeastern part of the county.

The surface layer is dark reddish-brown or reddish-brown silty clay loam that is free of lime, difficult to till, and about 10 inches thick. This layer has moderate, fine, granular structure.

The subsoil is a claypan. It contains slightly more clay than the surface soil and is more compact in the upper part than in the lower. The upper part is reddish-brown to dark reddish-brown clay of weak, medium, blocky structure. The lower part is dark reddish-brown to yellowish-red, calcareous clay or silty clay loam of massive structure. The total thickness of the subsoil is about 40 inches.

The underlying material consists of fine-textured sediment derived from shale and clay. It is very fine, limy, and difficult for plant roots to penetrate.

Renfrow soils are naturally well drained. Internal drainage is medium, and permeability is very slow. The ability of these soils to hold and retain moisture is high. Natural fertility is high. In sloping fields these soils are susceptible to water erosion.

Renfrow soils are cultivated in most areas. They are suited to small grains, sorghums, legumes, and grass. Winter wheat is the crop most widely grown.

Renfrow silty clay loam, 0 to 1 percent slopes (RcA).—This soil is nearly level. It has the profile described as typical of the series. Included with this soil in mapping were small areas of Kirkland silt loam, 0 to 1 percent slopes, and of Tabler silty clay loam. Each of these included soils totals about 3 percent of the acreage.

Except for a few small areas in native grass, all of this soil is cultivated. Management is needed that maintains soil structure and fertility, improves the intake of water, and provides surface drainage. A good cropping system and proper tillage are essential. Also important

is the time of tillage, for this soil is often plowed when it is too wet. (Capability unit IIs–1; Claypan Prairie range site; woodland suitability group 3)

Renfrow silty clay loam, 1 to 3 percent slopes (RcB).—This soil is mainly on very gently sloping uplands. It is associated with the nearly level Renfrow and Kirkland soils. Included in mapping of this soil were small areas of Kirkland silt loam that total about 10 percent of the individual areas.

This soil is more sloping than Renfrow silty clay loam, 0 to 1 percent slopes, and has a thinner solum. In places the surface layer has been thinned by erosion, or it was never quite so thick as that in the series description.

The surface layer is generally reddish-brown or dark-brown silty clay loam, but there are small areas of clay loam included. The surface layer ranges from 7 to 10 inches in thickness, and the subsoil ranges from 20 to 50 inches.

Most of this soil is cultivated. Winter wheat is the principal crop. Management is needed that controls surface runoff, increases soil moisture, and maintains soil structure. Effective practices are terracing and contour farming combined with suitable crop rotation and tillage. (Capability unit IIIe–4; Claypan Prairie range site; woodland suitability group 3)

Renfrow-Vernon complex, 3 to 5 percent slopes, eroded (RnC2).—This complex is mostly on short slopes along some of the shallow intermittent drainageways. It consists of about 55 percent Renfrow silty clay loam and about 45 percent Vernon clay loam.

Erosion has thinned the surface layer of these soils to about 4 to 6 inches, and some of the subsoil material has been mixed with the surface layer through cultivation. Vernon clay loam has a dark-red to reddish-brown surface layer and a solum less than 20 inches thick. Renfrow silty clay loam has a reddish-brown to dark-brown surface layer. In many places partially weathered clay and shale are at a depth of about 30 inches.

Most areas of these soils are tilled. Winter wheat is the principal crop. Management is needed that controls runoff water and soil erosion and that maintains soil structure and fertility. Effective practices are terracing and contour farming and the seeding of legumes or other close-growing crops each year. Planting row crops is not advisable. Eroded areas can be improved by reseeding native grass. (Capability unit IVe–5; Renfrow soil in Claypan Prairie range site, and Vernon soil in Red Clay Prairie range site; woodland suitability group 3)

Rough Broken Land

Rough broken land (Ro) consists mainly of a long, narrow outcropping of gypsum hills and clayey red beds. Slopes range from 10 to 45 percent.

These outcrops cross the county in a northwest-southeast direction. Facing east is an escarpment about 200 to 300 feet high that exposes three distinct beds of white gypsum interbedded with red-brown and gray-green shale. These gypsum beds range from 6 to 15 feet in thickness. Very deep, V-shaped canyons have been cut through the range of hills by streams that flow eastward and into the Cimarron River. This escarpment area, including its network of canyons, is very droughty and subject to severe erosion. It supports only a very thin stand of native grass and a few small redcedars.

This land is suited to native grass, as habitat for wildlife, and as recreational areas.

The gypsum layers are mixed for commercial use. Finely ground, nearly pure gypsum is used for treating slickspots in cultivated fields. (Capability unit VIIs–1; Breaks range site; woodland suitability group 4)

Sandy Broken Land

Sandy broken land (Sb) is made up of sandy soil material that overlies clay and shale. It is the top part of a range of hills that faces east. Slopes range from 8 to 20 percent.

This land is a long, narrow, broken strip that supports a thick cover of blackjack oak and some tall grasses. A few small areas of Nobscot fine sand, hummocky, are on the less steep slopes. These soils grade to deep sandy accumulations that end abruptly on steep eroded clay and shale.

All of this land type is in native grass. It is well suited to grazing. The moderately steep slopes are not suitable for cultivation. Little bluestem and sand bluestem are the most abundant grasses, but protection from overgrazing and fire is needed on range. (Capability unit VIe–1; Deep Sand Savannah-Breaks range site; woodland suitability group 4)

Shellabarger Series

The Shellabarger series is made up of deep, dark-colored loamy soils on nearly level to sloping uplands. These soils are in the central and west-central parts of the county.

The surface layer is dark-brown, slightly acid fine sandy loam. This layer is of granular structure, is easily tilled, and is about 12 inches thick.

The subsoil contains more clay in the middle part than in the upper or lower parts. The upper part is dark-brown, slightly acid light sandy clay loam of weak, fine, subangular blocky structure. The middle part is brown or dark-brown, neutral sandy clay loam of weak, medium, subangular blocky structure. The lower part is strong-brown or dark-brown, neutral heavy sandy loam of weak, fine, granular structure. The total thickness of the subsoil is about 34 inches.

The underlying material consists of loamy or sandy earths that are friable, about neutral, and easily penetrated by plant roots.

Shellabarger soils are naturally well drained. Internal drainage is medium, and permeability is moderate. The ability of these soils to absorb and retain moisture is moderate. Natural fertility is medium to high, but soil blowing and water erosion are likely.

Shellabarger soils are cultivated in most areas. They are suited to small grains, grain sorghums, cotton, legumes, and grass. Winter wheat is the crop most widely grown.

Shellabarger fine sandy loam, 0 to 3 percent slopes (ShA).—This soil is nearly level to very gently sloping. It has the profile described as typical of the series.

Included with this soil in mapping were small areas of Pratt loamy fine sand, undulating, and of Teller fine sandy loam, 1 to 3 percent slopes. The included areas of each of these soils total about 3 percent of the acreage. Also included were small areas of Vanoss loam, 1 to 3 percent slopes, and Carwile-Shellabarger complex, 0 to 2 percent slopes. The included areas of each of these soils total about 2 percent.

This is one of the most desirable soils in the county for farming. Except for a few small areas of native grass, all of it is cultivated. It is suited to small grains, grain sorghums, cotton, legumes, and grass. Winter wheat is the main crop.

Management is needed that controls water erosion and soil blowing and maintains soil fertility and structure. Effective practices are rotating crops and legumes on terraces and in areas of contour farming. Crop residue left on the soil and tillage at a minimum help to control soil blowing. (Capability unit IIe-2; Sandy Prairie range site; woodland suitability group 1)

Shellabarger fine sandy loam, 3 to 5 percent slopes (ShC).—This soil is on gently sloping sandy uplands. It is associated with very gently sloping Shellabarger, Pratt, Norge, and Teller soils.

Included with this soil in mapping were small areas of Teller fine sandy loam, 3 to 5 percent slopes, that total about 5 percent. Also included were small areas of Pratt loamy fine sand, undulating, that total 3 percent, and of Norge loam, 3 to 5 percent slopes, that total 2 percent.

The surface layer of this Shellabarger soil is about 10 inches thick, or 2 inches thinner than that described for the series. In several small areas where there are small rills, the surface layer has been thinned to 6 to 8 inches by erosion. Where the soil is plowed, all or nearly all of the surface layer and part of the subsoil is mixed, and the plow layer is lighter colored than that in the less eroded areas.

Nearly all of this soil is cultivated. Winter wheat is the principal crop. Management is needed that controls water erosion and soil blowing and maintains fertility. Among the necessary practices are terracing, tilling on the contour, and using a suitable crop rotation that includes legumes. (Capability unit IIIe-2; Sandy Prairie range site; woodland suitability group 2)

Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes (StD).—These soils are on sloping sandy uplands that are mostly in the southeastern and southwestern parts of the county. They are associated with very gently sloping to gently sloping Shellabarger and Teller soils. About 50 to 65 percent of this complex is Shellabarger fine sandy loam, and about 35 to 50 is Teller fine sandy loam.

Included with these soils in mapping were Grant silt loam, 5 to 8 percent slopes, and Dill fine sandy loam, 5 to 8 percent slopes. The included areas of each of these soils total about 5 percent of the acreage.

The Shellabarger soils have a profile similar to the one described for the Shellabarger series, but the surface layer is 7 to 9 inches thick instead of 12 inches, and the lower subsoil ranges from yellowish red to dark brown. The profile of the Teller soils is like the one described for the Teller series.

Most of the acreage is in native grass. Management is needed that controls soil blowing and water erosion and maintains fertility. Terraces and contour farming are effective. Also needed is a cropping system that provides small grains, usually winter wheat, legumes, or fertilizer. Row crops should not be grown. (Capability unit IVe-6; Sandy Prairie range site; woodland suitability group 3)

Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes, eroded (StD2).—These soils are on sloping, eroded sandy uplands in the southwestern part of the county. They are associated with very gently sloping to gently sloping Shellabarger and Teller soils. This complex is made up of about 50 to 60 percent Shellabarger fine sandy loam and 40 to 50 percent Teller fine sandy loam.

Included with these soils in mapping were small areas of Grant silt loam, 4 to 8 percent slopes, eroded, and of Dill fine sandy loam, 5 to 8 percent slopes, eroded. Included areas of each of these soils total about 5 percent of the acreage.

This mapping unit has a thinner surface layer than Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes. In most areas erosion has removed 25 to 50 percent of the surface layer and left this layer only 4 to 7 inches thick. In about 2 percent of the acreage, all of the surface layer has been removed and the subsoil is exposed. In plowed fields 35 to 45 percent of the plow layer is a mixture of all the surface layer and the upper part of the subsoil.

In some areas where runoff accumulates, gullies form and gradually work their way upslope. In most places these gullies are not more than 300 feet apart, but they cannot be filled by normal tillage.

Nearly all of the acreage is in cultivation or has been tilled. Winter wheat is the main crop, but permanent pasture is a better use than cultivated crops. Management is needed that controls water erosion and soil blowing and maintains fertility. Effective practices are contour farming, terracing, and growing legumes half of the time or applying fertilizer. Where cultivated, these soils should be seeded to sown crops, but not to row crops. (Capability unit IVe-4; Sandy Prairie range site; woodland suitability group 3)

St. Paul Series

In the St. Paul series are deep, dark-colored, nearly level to very gently sloping soils of the uplands (fig. 6). These soils are in the northwestern part of the county.

The surface layer is brown, neutral silt loam of granular structure. This layer is about 12 inches thick and is moderately easy to till.

The subsoil contains more clay and is more compact in the lower part than in the upper. The upper part is a dark-brown light silty clay loam of moderate, fine, subangular blocky structure. The lower part is dark-brown, moderately alkaline silty clay loam of moderate, medium, subangular blocky structure. The total thickness of the subsoil is about 38 inches.

The underlying material consists of silty material that is firm, limy, and moderately difficult for plant roots to penetrate.

St. Paul soils are naturally well drained. Internal drainage is medium, and permeability is moderately

Figure 6.—**Profile of St. Paul silt loam.**

slow. The ability of these soils to absorb and retain moisture is moderate. Natural fertility is high.

St. Paul soils are cultivated in most areas. They are suited to small grains, sorghums, cotton, legumes, and grass. Winter wheat is the crop most widely grown.

St. Paul silt loam, 0 to 1 percent slopes (SpA).—This soil is nearly level. It has the profile described as typical of the series.

Included with it in mapping were small areas of Bethany silt loam, 0 to 1 percent slopes, and of Vanoss loam, 0 to 1 percent slopes. Included areas of each of these soils total about 3 to 4 percent of the acreage.

This is one of the most desirable soils in the county for farming. Except for a few small areas in native grass, all of it is cultivated. It is suited to small grains, sorghums, cotton, legumes, and grass. Winter wheat is the main crop.

Management is needed mainly for maintaining soil structure. Effective practices are using proper tillage, using crop residue, and seeding close-growing crops. (Capability unit IIc-1; Hard Land range site; woodland suitability group 2)

St. Paul silt loam, 1 to 3 percent slopes (SpB).—This soil is on very gently sloping uplands in the west-central part of the county. It is associated with the nearly level St. Paul and Vanoss soils.

Included with this soil in mapping were small areas of Grant silt loam, 1 to 3 percent slopes, that make up 5 percent of the acreage, and of Vanoss loam, 1 to 3 percent slopes, that cover 5 percent.

The surface layer of this soil has been thinned by erosion in some places, or it was never quite so thick as the one described for the series. This layer is silt loam that ranges from 10 to 12 inches in thickness. The surface layer and subsoil are brown or dark brown. The upper subsoil is about 8 inches thick. The lower subsoil is silty clay loam or heavy silty clay loam.

This soil is cultivated in most areas. Winter wheat is the principal crop. Management is needed that controls water erosion and maintains soil structure and fertility. Productivity can be maintained if the crops are all sown crops and stubble mulch is used each year. If row crops are grown, it is necessary to limit them to 6 consecutive years to cultivate on terraces and on the contour, and to include legumes or fertilizer in the cropping system. (Capability unit IIe-3; Hard Land range site; woodland suitability group 2)

Tabler Series

The Tabler series consists of deep, dark-colored, nearly level soils of the uplands. These soils are in the north-central part of the county.

The surface layer is dark grayish-brown, neutral silty clay loam. This layer is of granular structure, is about 8 inches thick, and is difficult to till.

The subsoil contains more clay and is more compact in the upper part than in the lower. The upper part is very dark gray clay of weak, fine, subangular blocky structure. The total thickness of the subsoil is about 26 inches.

The underlying material consists of silty material that is firm, calcareous, and difficult for plant roots to penetrate.

Tabler soils are moderately well drained. Internal drainage is slow, and permeability is very slow. The ability of these soils to absorb and retain moisture is high.

Tabler soils are cultivated in most areas. They are suited to small grains, sorghums, legumes, and grass. Winter wheat is the crop most widely grown.

Tabler silty clay loam (Ta).—This soil is in shallow swales and nearly level areas. Included with it in mapping were small areas of Kirkland silt loam, 0 to 1 percent slopes, that total 5 percent of the acreage, and of Bethany silt loam, 0 to 1 percent slopes, that cover 3 percent.

Except for a few small areas in native grass all of this soil is cultivated. It is one of the more desirable soils in the county for small grains. Winter wheat is the principal crop.

Because of the claypan subsoil and the position of this soil on the landscape, surface drainage is required in

many places. For short, frequent periods this soil is too wet for cultivation. Management is needed for maintaining soil structure and fertility. Effective practices are seeding close-growing crops each year and using suitable tillage when this soil is not too wet. Slickspots occur, and they can be treated by mulching with straw or hay, or by applying gypsum. (Capability unit IIs-2; Claypan Prairie range site; woodland suitability group 3)

Teller Series

The Teller series consists of deep, reddish-brown, very gently sloping to sloping loamy soils of the uplands. They are in the southwestern part of the county.

The surface layer is brown or reddish-brown, medium acid fine sandy loam of granular structure. It is easily tilled and is about 10 inches thick.

The subsoil contains more clay in the middle part than in the lower. The upper part is a reddish-brown or dark reddish-brown, medium acid loam of moderate, medium, granular structure. The middle part is yellowish-red or red, slightly acid light clay loam of moderate, medium, granular structure. The lower part is a yellowish-red or red, slightly acid fine sandy loam of weak, fine granular structure. The total thickness of the subsoil is about 50 inches.

The underlying material is loose and loamy, slightly acid or medium acid, and easily penetrated by plant roots.

Teller soils are naturally well drained. Internal drainage is medium, and permeability is moderate. The ability to absorb and retain moisture is moderate. These soils are moderately high in natural fertility but are susceptible to soil blowing and water erosion.

About half the acreage of Teller soils is cultivated. These soils are suited to small grains, grain sorghums, cotton, legumes, and grass. Winter wheat is the crop most widely grown.

Teller fine sandy loam, 1 to 3 percent slopes (TfA).—This soil is very gently sloping. It has the profile described as typical of the series. Included with this soil in mapping were small areas of Shellabarger fine sandy loam, 0 to 3 percent slopes, that total 5 to 7 percent of the acreage and of Grant silt loam, 1 to 3 percent slopes, that cover 2 or 3 percent.

This is one of the most desirable soils in the county for farming. Except for a few small areas in native grass, all of it is cultivated. It is suited to small grains, cotton, and legumes. Winter wheat is the main crop.

Management is needed that controls water erosion and soil blowing and that maintains soil structure and fertility. Soil blowing can be reduced by tilling at a minimum and by leaving crop residue on the surface. Terraces and contour farming are effective in keeping this soil productive if they are used with a cropping system that includes legumes or fertilizer. (Capability unit IIe-2; Sandy Prairie range site; woodland suitability group 1)

Teller fine sandy loam, 3 to 5 percent slopes (TfC).—This soil is on gently sloping, eroded uplands in the southwestern part of the county. It is associated with very gently sloping Teller and Shellabarger fine sandy loams and Grant silt loam.

Included with this soil in mapping were small areas of Shellabarger fine sandy loam, 3 to 5 percent slopes, that total about 10 percent of the acreage, and of Grant silt loam, 3 to 5 percent slopes, that cover 5 percent.

The surface layer of this soil has been thinned by erosion in some places, or it was never quite so thick as the one described for the series. In most places the surface layer is reddish-brown to brown fine sandy loam, but in some small included areas it is loam. It ranges from 6 to 10 inches in thickness. The lower subsoil is red to yellowish-red heavy loam to clay loam.

Most areas of this soil are cultivated. Winter wheat is the principal crop. Management is needed to control water erosion and soil blowing and to maintain fertility. An effective cropping system is one that provides a suitable rotation that includes legumes or grasses or that provides for additions of fertilizer. Also needed are terraces and contour farming. (Capability unit IIIe-2; Sandy Prairie range site; woodland suitability group 1)

Tivoli Series

The Tivoli series consists of deep, light-colored, loose sandy soils. These soils are on moderately steep to steep sand dunes near the North Canadian River.

The surface layer is grayish-brown or pale-brown, neutral fine sand. This layer is structureless and about 8 to 10 inches thick. It is underlain by deep, loose fine sand that has been reworked by wind. This material is neutral and very easily penetrated by plant roots.

Tivoli soils are excessively drained. Internal drainage is very rapid, and permeability is rapid. The ability of these soils to hold and retain moisture is very poor. Natural fertility is very low, and soil blowing is very likely.

Tivoli soils are not suitable for cultivation. They are used for native grass range and wildlife habitat.

Tivoli fine sand, rolling (TrD).—This soil is on a high, broken ridge of sandhills near the north side of the valley of the North Canadian River. Slopes range from 10 to 30 percent. Included with this soil in mapping were small areas of Pratt loamy fine sand, hummocky, that total 2 percent of individual areas.

A thin stand of tall grasses and sagebrush stabilize Tivoli fine sand against soil blowing. A few elm and cottonwood trees grow near the base of the sandhills.

This soil is not suitable for cultivation. All of it is in native grass and is used as wildlife habitat. (Capability unit VIIe-1; Dune range site; woodland suitability group 4)

Vanoss Series

The Vanoss series consists of deep, dark-colored loamy soils on nearly level to very gently sloping uplands. These soils are in the west-central and southern parts of the county.

The surface layer is brown or dark-brown, slightly acid loam of granular structure. It is moderately easy to till and is about 16 inches thick.

The upper part of the subsoil is brown or dark-brown light clay loam of weak, fine, subangular blocky struc-

ture. The lower part is dark-brown or dark yellowish-brown, neutral clay loam or heavy clay loam of moderate, medium, subangular blocky structure. The total thickness of the subsoil is about 46 inches.

The underlying material is firm, neutral, and loamy. Penetrating this material is moderately difficult for plant roots.

Vanoss soils are naturally well drained. Internal drainage is medium, and permeability is moderate. The ability of these soils to absorb and retain moisture is moderate. Natural fertility is high.

Vanoss soils are cultivated in most areas. They are suited to small grains, grain sorghums, cotton, legumes, and grass. Winter wheat is the crop most widely grown.

Vanoss loam, 0 to 1 percent slopes (VoA).—This soil is nearly level. It has the profile described as typical of the series. Included with this soil in mapping were small areas of Minco loam, 0 to 1 percent slopes, that total 5 percent of the acreage; of St. Paul silt loam, 0 to 1 percent slopes, that total 3 percent; and of Shellabarger fine sandy loam, 0 to 3 percent slopes, that cover 3 percent.

This is one of the most desirable soils in the county for farming. Except for a few small areas in grass, all of it is cultivated. It is suited to small grains, grain sorghums, and grass. Winter wheat is the main crop.

The management needed to keep this soil productive includes maintaining soil structure and fertility. An effective practice is using a cropping system that provides close-growing crops and legumes or that provides for additions of fertilizer. Planting row crops for more than 6 consecutive years is not advisable. (Capability unit I–2; Loamy Prairie range site; woodland suitability group 1)

Vanoss loam, 1 to 3 percent slopes (VoB).—This soil occurs on very gently sloping uplands in the central and southwestern parts of the county. It is associated with nearly level Vanoss, St. Paul, Shellabarger, and Minco soils.

Included with this soil in mapping were areas of Shellabarger fine sandy loam, 0 to 3 percent slopes, and of Minco loam, 1 to 3 percent slopes. The included areas of each of these soils total 3 percent of the acreage.

The surface layer of this soil has been thinned by erosion, or it was never quite so thick as the one in the profile described for the series. It ranges from 8 to 16 inches in thickness. This layer is mostly brown or dark-brown loam, but small included areas are fine sandy loam. The upper part of the subsoil is dark brown to brown, and the texture of the lower part ranges from clay loam to light silty clay loam.

Most of this soil is cultivated. Winter wheat is the principal crop. Management is needed for controlling water erosion and maintaining soil structure and fertility. Suitable practices are terracing and contour farming and the use of a crop rotation that provides legumes. (Capability unit IIe–1; Loamy Prairie range site; woodland suitability group 2)

Vernon Series

The Vernon series consists of shallow, very gently sloping to sloping soils of the uplands in the northeastern part of the county.

The surface layer is reddish-brown, calcareous clay loam of granular structure. It is about 8 inches thick and is difficult to till.

The subsoil is about 9 inches thick. It contains a little more clay and is more compact in the lower part than in the upper. The subsoil is red, calcareous light clay of moderate, medium, granular structure.

Underlying the subsoil are siltstone and shale that are calcareous along the joints and bedding planes. Plant roots follow these lines of weakness in the rock layers.

Vernon soils are naturally well drained. Internal drainage is medium, and permeability is slow. The ability of Vernon soils to absorb and retain moisture is high. These soils are medium in natural fertility and, in tilled areas, are susceptible to water erosion.

Vernon soils are used mainly for grass. About one-fourth of the acreage is cultivated. Winter wheat is the principal crop.

Vernon clay loam, 1 to 3 percent slopes (VeB).—This very gently sloping soil is shallow, slowly permeable, droughty, and difficult to till. It has the profile described as typical of the series. Included with this soil in mapping were small areas of Renfrow silty clay loam, 1 to 3 percent slopes, that total 6 to 8 percent of the acreage, and of Vernon soils and Rock outcrop that cover 2 percent.

About one-half of this soil is cultivated, and the rest is in native grass. Suitable crops are small grains, principally winter wheat, and sorghum.

Management is needed that protects this soil from runoff, that increases the intake of water, and that maintains soil structure. Effective practices are terracing and contour tillage used with a cropping system that provides close-growing crops, legumes, or fertilizer and the use of crop residue. (Capability unit IIIe–5; Red Clay Prairie range site; woodland suitability group 3)

Vernon clay loam, 3 to 5 percent slopes (VeC).—This soil is on gently sloping, eroded uplands, mostly in the eastern part of the county. It is associated with very gently sloping Vernon and Renfrow soils.

Included with this soil in mapping were areas of Renfrow silty clay loam, 1 to 3 percent slopes, that cover about 6 to 8 percent of the acreage, and very small areas of Vernon soils and Rock outcrop.

The surface layer is reddish-brown or red and slightly thinner than that described for the series.

Nearly all of this soil is in native grass. Grass for permanent pasture is a better use than cultivated crops. Management is needed that provides control of water erosion, increase of water intake, and maintenance of soil structure. Planting row crops is not advisable. A good practice is the rotation of sown crops and legumes, combined with terracing and contour farming. (Capability unit IVe–1; Red Clay Prairie range site; woodland suitability group 3)

Vernon soils and Rock outcrop (Vr).—This mapping unit consists of 75 percent Vernon soils and 25 percent Rock outcrop. Included in the unit are small, irregular areas of Rough broken land (fig. 7). Slopes range from 5 to 15 percent.

The Vernon soils are similar to Vernon clay loam, 1 to 3 percent slopes, except that the surface layer ranges

Figure 7.—Vernon soils in background and Rough broken land in foreground.

in texture from clay loam to clay and the depth to shale or compact clay averages about 10 inches.

The Rock outcrop consists of shale, sandstone, dolomite, and gypsum.

The principal grasses on the Vernon soils are sideoats grama, little bluestem, and blue grama, and there are also many forbs and legumes. Unless overgrazing is avoided, these plants thin out and die, and loss of soil and water follows. (Capability unit VIIs–2; Red Clay Prairie range site; woodland suitability group 4)

Wann Series

The Wann series consists of deep, dark-colored, nearly level soils on sandy alluvium. These soils occupy parts of the flood plains of the North Canadian and South Canadian Rivers.

In most places the surface layer is grayish brown or very dark grayish brown. It ranges from fine sandy loam to loam. This layer is calcareous, is easily tilled, and is about 10 inches thick. It overlies a layer of light yellowish-brown or very pale brown, calcareous light fine sandy loam of weak, fine, granular structure. This layer is about 22 inches thick.

The underlying material is sandy alluvium that is easily penetrated by plant roots.

Wann soils are somewhat poorly drained. Internal drainage is rapid, and permeability is moderately rapid. The ability of these soils to absorb and retain moisture is low. Natural fertility is low, and frequent flooding is likely.

Most areas of Wann soils are in grass. About one-fourth of the acreage is cultivated to grain sorghums and cotton.

Wann soils (Wa).—These soils are on nearly level flood plains. They are associated with the Lincoln and Leshara soils. Included with them in mapping were small areas of Lincoln loamy fine sand that total 6 to 8 percent of the acreage and of the Leshara-Slickspots complex that cover 3 to 4 percent.

Less than one-fourth of the acreage is cultivated; the rest is in native grass. Management is needed that maintains soil structure and fertility and gives some protection against flooding. Using a crop rotation that provides legumes helps to maintain fertility and structure if row crops are not grown for more than one-half of the time. Keeping a cover of grasses on these soils lessens damage by scouring or deposition. (Capability unit IIw–1; Loamy Bottom Land range site; woodland suitability group 2)

Wet Alluvial Land

Wet alluvial land (Wt) consists of soils on recent loamy alluvium. It is mostly near or along the North and South Canadian Rivers. Slopes range from 0 to 1 percent. This land is frequently flooded and normally has a high water table. Seep water is at or near the surface in many places.

The surface layer of Wet alluvial land varies in color and texture, but in most places it ranges from brown to dark grayish brown.

All of this land is in native grass. It is used for permanent pasture or wildlife habitat, or it lies idle. This land is well suited to permanent pasture. The most productive grasses are sand bluestem, switchgrass, and indiangrass. If pasture in these grasses is misused, saltgrass, alkali muhly, silver bluestem, and other less desirable grasses increase. (Capability unit Vw–1; Subirrigated range site; woodland suitability group 4)

Woodward Series

The Woodward series consists of moderately deep loamy soils of the uplands. These soils are in the western and southwestern parts of the county, mostly on moderately steep slopes.

The surface layer is red, calcareous loam of weak, fine, granular structure. It is about 10 inches thick. The subsoil, about 8 inches thick, is loam of weak, fine, granular structure. The underlying material at a depth of about 22 inches is weakly consolidated, calcareous sandstone.

Woodward soils are somewhat excessively drained. Internal drainage and permeability are moderate. The ability to absorb and retain moisture is low. These soils have low natural fertility and are very susceptible to water erosion unless management is good.

Woodward soils are used mostly for grass. Gently sloping areas are tilled in some places.

In this county Woodward soils are mapped only in a complex with Quinlan soils.

Yahola Series

In the Yahola series are deep, nearly level loamy soils formed in alluvium. These soils are on the flood plains of the South Canadian River and other large streams.

The surface layer is red or yellowish-red, calcareous loam of granular structure. This layer is easily tilled and is about 15 inches thick.

Directly under the surface layer is a layer about 20 inches thick that contains less clay in the lower part than in the upper. The upper part is a red sandy loam of

weak, fine, granular structure, and the lower part is red, calcareous sand.

The underlying material is friable, calcareous loamy and sandy alluvium that is easily penetrated by plant roots.

Yahola soils are naturally well drained. Internal drainage is medium, and permeability is moderate. The ability of these soils to absorb and retain moisture is moderate. Natural fertility is high, but flooding is frequent.

About half the acreage is cultivated. These soils are suited to small grains, grain sorghums, cotton, alfalfa, and grass. Winter wheat is the crop most widely grown.

Yahola loam (Yo).—This soil is on nearly level flood plains. It is generally associated with Port and Reinach soils. Included with this soil in mapping were small areas of Port loam that total about 6 to 8 percent of the acreage, and of Reinach very fine sandy loam that cover 2 or 3 percent.

More than three-fourths of this soil is in native grass, and the rest is cultivated. Most areas are better used as permanent pasture than as cropland because they are isolated.

Management is needed that maintains soil structure and fertility and that provides some protection against damage from flooding. A crop rotation that includes legumes helps to keep this soil productive. Planting row crops for more than 6 consecutive years is not advisable. Flood damage is reduced by a cover of grass or of crops. (Capability unit IIw-3; Loamy Bottom Land range site; woodland suitability group 1)

Use and Management of Soils

The soils of Blaine County are used mainly for tilled crops, range, and tame pasture. This section tells how the soils can be used for these main purposes, and also for woodland, for wildlife, and for building roads, farm ponds, and other engineering structures. In discussing management of soils for tilled crops, range, and woodland, the procedure is to group soils according to their suitability for those uses and to discuss the management of the groups of soils. Also given in this section are predicted yields of principal crops on the soils in the county suitable for cultivation.

Management of Soils for Tilled Crops [2]

In order to maintain favorable long-term yields, farmers generally recognize that wind and water erosion must be controlled; that poor rainfall distribution must be offset by practices to conserve moisture; that the content of organic matter must be maintained or increased; and that soil tilth must be maintained or improved.

In recent years increased surface crusting of soils and excessive tillage have focused increased attention on soil management. Improved crop yields indicate the need to use good crop varieties and to provide enough plant nutrients. In small local areas, special management is required because of a high water table, severe soil blowing, saline-alkali areas (slickspots), flooding of bottom lands, and overgrazing that destroys plant residue needed to protect and improve the soil.

A combination of practices generally is most effective in controlling erosion and otherwise managing cultivated soils. Among the practices suitable are using a conservation cropping system; practicing minimum tillage; using crop residue and stubble mulch; growing cover crops and green-manure crops; stripcropping; building terraces; farming on the contour; growing grass, legumes, or both in a long-term rotation with other crops; keeping waterways grassed; and adding fertilizer when local conditions warrant its use. The practices suggested for improved management in the subsection "Yield Predictions" can be used by farmers as a guide in selecting the set of practices needed on an individual farm.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The soils are classified according to degree and kind of permanent limitation, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible but unlikely major reclamation projects.

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest grouping, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I. Soils have few limitations that restrict their use.

Class II. Soils have some limitations that reduce the choice of plants or require moderate conservation practices.

Class III. Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV. Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.

Class V. Soils subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Class VII. Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.

[2] By M. D. GAMBLE, conservation agronomist, Soil Conservation Service.

Class VIII. Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-3 or IIIe-6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation, and the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs. The Arabic numeral specifically identifies the capability unit within each subclass.

Management of soils by capability units

In the following pages, the management of soils grouped in capability units is discussed. Given for each capability unit are important general features of the soils, suitable uses, and effective management practices. To find the soils in each capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

Because the soils in Blaine County are generally cultivated without irrigation, it is important to retain as much rainwater as possible and to use it efficiently. Practices are needed that decrease runoff, increase infiltration, prevent excessive evaporation, and increase the content of organic matter. For most uses, the soils should be protected against soil blowing and water erosion.

CAPABILITY UNIT I-1

This unit consists of deep, nearly level soils on the bottom lands near and along the larger creeks and in the river valleys. These soils have a loamy surface layer that is underlain by moderately fine textured to medium-textured layers.

The soils of this unit absorb and store water well and release it readily to crops. They are fertile, productive, drought resistant, suitable for intensive farming, and easy to moderately difficult to till. Soil erosion generally is not a hazard.

Crops suited to this area grow well on these soils. Wheat, alfalfa, and cotton are the principal crops.

Favorable yields of small grains can be expected for as much as 6 consecutive years, but then 2 years of sweetclover or another soil-improving crop are needed. Crops producing large amounts of residue can be grown year after year if stubble mulch is used, nitrogen is adequate, and all crop residue is returned to the soil. A winter cover crop should follow silage crops or other crops that leave little residue on the surface for soil protection.

CAPABILITY UNIT I-2

In this unit are deep, dark-colored soils on nearly level uplands. These soils have a silt loam or loam surface layer over a medium-textured to fine-textured subsoil. The soils of this unit absorb and store water well and release it readily to crops. They are fertile, are productive, and have medium internal drainage. Tillage is moderately easy, and intensive farming is suitable.

Under good management, these soils can be used intensively for all crops suited to this area. The principal crops are small grains, mostly wheat, alfalfa, and cotton.

Wheat is generally grown year after year, but a grain sorghum may be occasionally substituted for the wheat. Yields of winter wheat or another small grain are favorable if adequate amounts of fertilizer and crop residue are used. It is not advisable to plant cotton, sorghums harvested for silage, or other soil-depleting crops for more than 6 consecutive years. Contour farming is necessary where row crops are grown.

Practices are needed that maintain the fertility and structure of these soils. Alfalfa or some other legume in the cropping system helps to maintain soil structure and to increase the intake of water. Leaving cropland fallow generally increases the supply of moisture and leads to higher crop yields the following year. Ordinary management generally is sufficient to control water erosion, but in some places diversion terraces are needed on the foot slopes of adjacent higher land. Stubble mulching and cover crops help to control soil blowing.

CAPABILITY UNIT IIc-1

St. Paul silt loam, 0 to 1 percent slopes, is the only soil in this unit. This deep, dark-colored, productive soil is on uplands. It has a silty clay loam subsoil that is granular, moderately slowly permeable, and moderate in available water-holding capacity. Most of this soil is in the western part of the county where rainfall is slightly less favorable than that farther east.

This soil is suited to all crops commonly dryfarmed in the county. Wheat is the principal crop.

Favorable yields of wheat or other small grain can be expected for a maximum of 4 years, but 2 years of soil-improving crops are needed before this soil is again used for a small grain. Small grains and other close-growing crops can be planted year after year, if suitable amounts of fertilizer are applied and crop residue is properly managed. Row crops may be damaged in summer by drought. They should be farmed on the contour, but for not more than 4 consecutive years.

On this soil moderate practices are required to conserve soil moisture. Practices are also needed to maintain soil structure and fertility. This soil is moderately easy to till.

CAPABILITY UNIT IIe-1

This unit is made up of deep, dark-colored, well-drained soils on very gently sloping uplands. These soils have a loam or silt loam surface layer over a moderately fine textured to medium-textured subsoil. They are high in natural fertility, moderately permeable, friable, and easily tilled. Their ability to absorb moisture and release it to plants is good.

Under proper management these soils produce average yields of small grains, winter and summer legumes, and sorghums. Winter wheat, the principal crop, is generally grown year after year.

Favorable yields of small grains and row crops can be expected for a maximum of 6 years, but then 2 years of legumes or grasses are needed. Sown crops, including wheat, can be grown each year where stubble mulching and fertilizer are used. Contour farming is essential if row crops are grown.

Practices are needed to control runoff, to maintain the structure and fertility of these soils, and to protect them from erosion. Including alfalfa or sweetclover in the cropping system improves the intake of water and helps to maintain the structure and organic-matter content of these soils. If silage crops or other crops that leave little residue are grown, a winter cover crop is needed. Runoff and erosion can be reduced by planting cover crops, stubble mulching, terracing, and tilling on the contour. Changing the depth of tillage each year helps to reduce the formation of plowpans.

CAPABILITY UNIT IIe-2

The soils of this unit occur on uplands and are deep, loamy, and nearly level to very gently sloping. They have a fine sandy loam surface layer and a moderately fine textured to moderately coarse textured subsoil. These soils are friable, easy to till, and moderately high in fertility. Surface runoff depends on the slope and is slow to moderate.

The soils of this unit produce nearly all crops suited to the area if management is good and provides stubble mulching. Winter wheat, cotton, and grain sorghums are the principal crops.

A suitable cropping system is 6 years of small grains or row crops followed by 2 years of legumes or grasses. Contour farming is needed where row crops are grown. A crop of winter wheat should follow silage crops that leave little residue on the soil. If winter wheat or another sown crop is grown, stubble mulching and adequate amounts of fertilizer are needed each year. The use of crop residue is essential where stubble mulching is not used.

Practices are needed to control wind and water erosion and to maintain the fertility and structure of these soils. Using cover crops and plant residue helps to control erosion.

CAPABILITY UNIT IIe-3

In this unit are deep, very gently sloping soils of the uplands. These soils have a loam or silt loam surface layer and a moderately fine textured subsoil. Fertility is average, and tillage is moderately easy. These soils absorb and store water well and release it readily to crops.

Suitable crops are small grains, winter and summer legumes, and sorghums. Winter wheat is the principal crop and is generally grown year after year. Yields are favorable if management is good.

Favorable yields of small grains or other close-growing crops can be expected for a maximum of 6 years, but then 2 years of legumes, grasses, or other soil-improving crops are needed. Winter wheat or another sown crop can be grown year after year if stubble mulching is used and suitable amounts of fertilizer are applied. Also suitable for continuous cultivation is a small grain-legume mixture, such as rye and vetch. Contour farming is essential where row crops are grown, and 6 consecutive years is the limit for these crops.

Practices are needed to control runoff and erosion and to maintain fertility and soil structure. A stubble mulch, used with terracing and contour farming (fig. 8), helps to slow runoff and to reduce erosion. Alfalfa and sweetclover help to maintain the organic-matter content, to improve the soil structure, and to increase the intake of water. A winter cover crop should follow silage or other crops that leave little residue on the soil. Where moisture is adequate, crops respond to fertilizer. Changing the depth of tillage each year helps to reduce the formation of plowpans.

CAPABILITY UNIT IIw-1

Only Wann soils are in this unit. These nearly level soils have a dark-colored surface layer of variable texture over a fine sandy loam subsoil. They are deep, are mottled within 24 inches of the surface, and have a water table at a depth of 36 to 48 inches. These soils are on low benches in the river valleys and are subject to occasional flooding.

Wann soils are easily tilled but are low in natural fertility. They take in water well. In winter and spring, soil blowing is likely, particularly where cover is lacking or where tillage has been excessive.

Cotton, sorghums, small grains, and legumes are suited to these soils. Grain sorghums and cotton are the principal crops.

A suitable cropping system consists of 2 years of small grains or row crops followed by 2 years of soil-improving legumes or grasses. A winter cover crop should follow a silage crop or other crops that leave little residue on the soil. A suitable cover crop is a mixture of a small grain and a legume, such as rye and vetch.

Practices that help to control soil blowing are tilling to roughen the surface and leaving crop residue on the fields.

CAPABILITY UNIT IIw-2

Only Carwile-Shellabarger complex, 0 to 2 percent slopes, is in this unit. It is on uplands. The Carwile soil is deep and loamy. It is nearly level but has small swales or slight depressions. Its surface layer of fine sandy loam is underlain by a compact, mottled, sandy clay loam subsoil. The Shellabarger soil has a fine sandy loam surface layer and a sandy clay loam subsoil.

The soils of this unit are moderately fertile and easily tilled. Their ability to absorb water and release it to plants is good. In winter and spring, soil blowing is likely, particularly where cover is lacking or where tillage has been excessive.

Figure 8.—**Contour farming on St. Paul silt loam, 1 to 3 percent slopes.**

Small grains, sorghums, cotton, and legumes are suited to these soils. Winter wheat is the principal crop.

A suitable cropping system is 4 years of small grains or row crops followed by 4 years of soil-improving legumes or grasses. A winter cover crop should follow a silage crop or other crops that leave little residue on the soil.

Practices that help to control soil blowing are stripcropping, stubble mulching, and tilling to roughen the surface. Draining or filling shallow swales helps to insure crop production.

CAPABILITY UNIT IIw-3

This unit consists of deep, loamy soils that have a loam or clay loam surface layer underlain by clay loam, silty clay loam, or sandy loam. These soils are nearly level, fertile, drought resistant, easily tilled, and suitable for intensive farming. They absorb and store water well and release it readily to plants. Flooding damages crops on these soils in some years. It scours some areas and deposits sediment in others.

Wheat, alfalfa, and cotton are the principal crops. Favorable yields of small grains can be expected for a maximum of 6 years, but then 2 years of sweetclover or another soil-improving crop are needed before again seeding to a small grain. Crops producing large amounts of residue can be grown year after year if stubble mulch is used and enough nitrogen fertilizer is applied. A winter cover crop should follow a silage crop or other crops that leave little residue.

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Normal good management ordinarily maintains fertility and controls soil blowing and water erosion, but diversion terraces are needed along some foot slopes of adjacent uplands to prevent the accumulation of water.

CAPABILITY UNIT IIs-1

In this unit are deep, nearly level soils that have a silt loam or silty clay loam surface layer. Their subsoil is compact clay that is very slowly permeable. It restricts the growth of roots and limits the amount of water available to plants.

The soils of this unit are droughty. A crust forms on their surface after rains and hinders the movement of water and air into the soils.

Most of the acreage of these soils is cultivated. Winter wheat is the principal crop, but other small grains and sorghums are also grown.

A suitable cropping system consists of 6 years of small grains followed by 2 years of soil-improving legumes or grasses. Sown crops can be grown year after year if all crop residue is returned to the soil and an adequate amount of fertilizer is applied. Contour tillage is needed if row crops are grown, but 6 consecutive years is the limit for these crops.

Practices are needed that improve soil structure and increase the intake of water. In places surface drainage is needed. The intake of water can be increased by seeding sweetclover, alfalfa, or other deep-rooted legumes. Both crusting and soil blowing are reduced by leaving crop residue on the surface. Changing the depth of till-

age each year helps to prevent the formation of plowpans.

CAPABILITY UNIT IIs-2

Only Tabler silty clay loam is in this capability unit. This deep, dark-colored, moderately well drained soil is on nearly level uplands. Its silty clay loam surface layer is underlain by a fine-textured subsoil that has a claypan. Slickspots and shallow swales occur in places.

This moderately productive soil is difficult to till. Most of it is cultivated. Winter wheat is the main crop, but other small grains are also grown. Row crops are seldom grown.

A suitable cropping system consists of 6 years of small grains followed by 2 years of a soil-improving legume, such as Austrian winter peas. Grasses can be substituted for the legume. Sown crops can be grown year after year if all crop residue is returned to the soil and enough fertilizer is added.

Practices are needed that help to increase water intake and improve soil structure and fertility. In some places surface drainage is needed. The intake of water can be improved by planting sweetclover, alfalfa, or another deep-rooted legume. Surface crusting and soil blowing are reduced if crop residue is left on the surface. Contour tillage is essential if row crops are grown. The slickspots can be improved by applying gypsum. Tilling to a different depth each year helps to prevent the formation of plowpans.

CAPABILITY UNIT IIIe-1

In this unit are deep, dark-brown to reddish-brown, gently sloping soils of the uplands. These soils have a loam or silt loam surface layer over a moderately fine textured to medium-textured subsoil. Natural fertility is moderately high, and moisture-holding capacity is good.

Most of the acreage in this capability unit is cultivated. Winter wheat is the principal crop, but other small grains, sorghums, and legumes are also suitable. Wheat commonly is grown year after year. If management is good, yields are favorable.

A suitable cropping system consists of 4 years of small grains or row crops followed by 4 years of soil-improving legumes or grasses. Also suitable is 2 years of small grains followed by 2 years of legumes. If winter wheat or another sown crop is grown continuously, it is necessary to leave all crop residue, to till on the contour, and to add enough fertilizer.

Practices are needed that control runoff and water erosion and that maintain fertility and soil structure. Terracing and contour farming are essential if row crops are grown. These practices help protect the soil, and they increase water intake. A winter cover crop should follow silage or other crops that leave little residue on the soil. If terraces are not used, perennial plants should be seeded in the natural drainageways. Changing the depth of tillage helps to reduce the formation of plowpans.

CAPABILITY UNIT IIIe-2

In this unit are deep soils of the uplands. They have a fine sandy loam surface layer over a moderately fine textured to moderately coarse textured subsoil. Soil blowing is likely where tillage is excessive or where cover is inadequate.

The soils of this unit are moderately fertile and are easily tilled. Suitable crops are small grains, sorghums, cotton, and legumes. Wheat is the principal crop.

A suitable cropping system consists of 3 years of small grains or row crops followed by 3 years of legumes or grasses. Sown crops can be grown year after year if stubble mulching is used and enough fertilizer is added. A winter cover crop should follow a silage crop or other crop that leaves little residue on the surface.

Practices are needed that control runoff and soil blowing and that maintain soil structure and fertility. Soil blowing can be decreased by stubble mulching or by stripcropping crosswise to the direction of the prevailing winds. If terraces are not used, the natural drains should be seeded to perennial plants. Changing the depth of tillage helps to reduce the formation of plowpans.

CAPABILITY UNIT IIIe-3

In this unit are deep soils of the uplands. These soils have a loamy fine sand surface layer over a moderately coarse textured to moderately fine textured subsoil.

These soils are loose, friable, and easily tilled, but their natural fertility and content of organic matter are low. They take in water at a moderate to moderately rapid rate, but little of it is held available to plants. Moderate to severe soil blowing is likely, especially in winter and early in spring.

These soils are suited to many kinds of crops. The principal crops are small grains, sorghums, cotton, and legumes. Alfalfa is also grown, generally under irrigation.

A suitable cropping system consists of 3 years of small grains or row crops followed by 3 years of grasses or legumes. Also suitable is a mixture of a small grain and a winter legume, such as rye or vetch, grown year after year. Winter wheat or another sown crop can also be grown year after year, if stubble mulching and minimum tillage are used and a suitable amount of fertilizer is added. A winter cover crop should follow a silage crop or other crops that leave little residue on the soil.

Practices are needed that control soil blowing, increase the intake of water, and maintain fertility and soil structure. Planting legumes and using crop residue are ways of helping to maintain fertility and soil structure and to increase the intake of water. Soil blowing can be decreased by planting trees in windbreaks, by stubble mulching, and by stripcropping crosswise to the direction of the prevailing wind.

CAPABILITY UNIT IIIe-4

Only Renfrow silty clay loam, 1 to 3 percent slopes, is in this unit. It is a deep, droughty soil that has a silty clay loam surface layer and a fine-textured subsoil. Runoff is medium. Some of the original surface layer has been removed by erosion, especially in areas where this soil has been cultivated and poorly managed. Tilling is difficult.

Winter wheat is the principal crop, but other small grains and sorghum are suitable. Sweetclover and winter legumes, such as Austrian winter peas, are sometimes grown.

Favorable yields of small grains and sorghums can be expected for 4 consecutive years, but then at least 2 years of legumes, grasses, or a legume-grass mixture are needed before grain is grown again. Sown crops can be seeded year after year if enough fertilizer is added and crop residue is properly managed. A winter cover crop should follow a silage crop or other crops that leave little residue. A small amount of phosphate is often applied to this soil at seeding time.

Practices are needed that control runoff, conserve moisture, and maintain soil structure and fertility. Terracing and contour farming are generally used. Natural drains should be kept in perennial plants. Using crop residue and stubble mulch helps to maintain soil structure and productivity. Leaving this soil fallow as long as possible allows it to store moisture for use the following year. Holding as much rainfall as possible on the soil reduces the amount of erosion and increases the amount of water for crop use. Tilling the soil soon after crops are harvested increases the intake of water, controls the growth of weeds, and hastens the decay of crop residue. Tilling to a different depth each year helps to prevent the formation of plowpans.

CAPABILITY UNIT IIIe-5

Only Vernon clay loam, 1 to 3 percent slopes, is in this unit. This reddish-brown, shallow, droughty soil is underlain by red shale at a depth of 10 to 20 inches. Permeability is very slow. This soil is low in natural fertility and is susceptible to water erosion. In most cultivated areas, some of the original surface soil has been lost through erosion.

Winter wheat is the principal crop, but other small grains, sweetclover, and winter legumes are grown occasionally. Yields are fairly low.

A suitable cropping system consists of 3 years of small grains or row crops followed by 3 years of grasses or legumes. Generally, winter wheat or another sown crop can be grown for three-fourths of the time, if legumes or grasses are grown the rest of the time, if crop residue is returned to the soil, and if enough fertilizer is added.

Management is needed that controls runoff. Plowing under cover crops and crop residue helps to improve soil structure, to increase the intake of water, and to maintain the content of organic matter. In the more sloping areas, terracing and contour farming can be used to prevent the accumulation of water. Natural drains should be kept in perennial plants.

CAPABILITY UNIT IIIe-6

Only Lincoln loamy fine sand is in this unit. It is a deep, sandy, dark-colored, nearly level soil on bottom lands. Fine sand is at a depth of about 18 inches. Generally, this soil is near river channels and is subject to flooding. It is well drained, is easily tilled, and has low natural fertility.

Grain sorghums and cotton are suited to this soil, but most of the acreage is in native grass. Yields of row crops are moderate.

A suitable cropping system consists of 3 years of a small grain followed by 3 years of a soil-improving crop. A small grain-legume mixture can be used year after year. A winter cover crop should follow a silage crop or other crops that leave little residue on the soil.

Practices are needed that control soil blowing and that maintain fertility. Wind erosion can be decreased by stripcropping crosswise to the direction of the prevailing wind.

CAPABILITY UNIT IIIs-1

In this unit are two nearly level to very gently sloping soil complexes. These complexes are in the uplands and consist of deep soils and slickspots. The surface layer of the soils is silt loam or loam, and the subsoil is moderately fine textured. The surface layer of the slickspots is generally silty clay loam or clay loam. Slickspots, which are more noticeable in cultivated fields, make up 10 to 25 percent of the acreage in this unit.

Small grains are the most common crops. Near failure of crops is common on the slickspots, mainly because they contain white alkali, crust at the surface, and take in water slowly. These conditions, however, do not affect the surrounding soils.

For obtaining average yields, a suitable cropping system consists of 6 years of winter wheat or sorghums followed by 2 years of legumes or grasses. In this system stubble mulching, returning crop residue to the soil, and adding fertilizer are essential. Also required is minimum tillage to a depth of about 4 inches. The slickspots are in small areas and are managed in about the same way as the soils around them.

Practices are needed that maintain soil structure and fertility and that increase the intake of water. Among these practices are returning crop residue to the soil, stubble mulching, and growing legumes and grasses. Natural drains should be kept in perennial plants. The slickspots can be improved by adding 3 to 5 tons of gypsum per acre and leaving the treated area untilled for 2 years to allow gypsum to react with the soil and thus prevent crusting. Another treatment consists of applying 3 or 4 tons of cotton burs, hay, or straw together with 20 pounds of nitrogen per acre.

CAPABILITY UNIT IVe-1

Only Vernon clay loam, 3 to 5 percent slopes, is in this unit. It is a shallow, droughty soil of the uplands. The clay loam surface layer is underlain by a fine-textured subsoil that grades to unweathered clay and shale at a depth of about 10 to 20 inches. Permeability is very slow, runoff is excessive, and soil blowing is likely. Tillage is difficult.

Most cultivated areas of this soil are used for small grains. Winter wheat is the principal crop, but other small grains, sorghums, and legumes are suitable. This soil is not well suited to cultivated crops.

A suitable cropping system consists of 6 years of small grains, usually winter wheat, followed by 2 years of soil-improving crops. In this system terracing, contour farming, and crop residue management are essential. Sown crops can be grown year after year, if for one-half of the time they are soil-improving crops, if stubble mulch and contour tillage are used, and if adequate amounts of fertilizer are added. Including row crops in the cropping system is not advisable.

Practices are needed that improve soil fertility, increase the intake of water, and control water erosion. Legumes, particularly sweetclover, help to improve soil fertility and to increase the intake of water. Holding as much

rainfall as possible on the soil helps to control erosion, and it allows extra moisture to be taken in for crop use. Terracing and contour farming also help control erosion and conserve moisture. Drainageways should be kept in perennial plants. Changing the depth of tillage helps to prevent the formation of plowpans.

CAPABILITY UNIT IVe-2

In this unit are deep, gently sloping to sloping soils in the uplands. These soils have a loamy surface layer and generally a finer textured subsoil. They are subject to excessive runoff and to moderate or severe water erosion and moderate soil blowing. Soil blowing increases where fields lack cover or are improperly tilled. These soils are friable and easily tilled, but they are low in natural fertility.

The soils in this unit are used mostly for winter wheat and other small grains, but sorghums and legumes are also suitable. Row crops are not suited to these soils.

A suitable cropping system consists of 3 years of small grains followed by 1 year of legumes or grasses. Sown crops can be grown continuously if the crops are soil-improving ones for one-half of the time and if stubble mulching, stripcropping, and contour tillage are used. The use of fertilizer is optional.

Protecting the natural drains by establishing perennial vegetation is advisable. Soil blowing can be decreased by stubble mulching or, where practical, by stripcropping crosswise to the direction of the prevailing wind. In spring a good practice is to delay the preparation of seedbeds until near planting time.

Growing legumes, stubble mulching, and using crop residue help to maintain soil structure and fertility and to increase the intake of water. Terracing and contour farming are essential in preventing the accumulation of water and in reducing the loss of soil and water. Changing the depth of tillage each year helps to reduce the formation of plowpans.

CAPABILITY UNIT IVe-3

Only Konawa loamy fine sand, hummocky, is in this unit. This deep, sandy soil is in the uplands and has a sandy clay loam subsoil. It is friable, is easily tilled, and has low natural fertility. The intake of water is moderate to moderately rapid, but the water-holding capacity is low. This soil is susceptible to severe soil blowing and moderate water erosion, especially in spring.

Grain sorghums and legumes are suited to this soil, but row crops should not be grown.

Sown crops, usually sorghums, can be grown year after year if stubble mulching, minimum tillage, and adequate amounts of fertilizer are used. A mixture of a small grain and a legume, such as rye and vetch, can be grown year after year. These plants provide good grazing and excellent cover during winter and early in spring. All natural drains should be kept in perennial plants.

Practices are needed that control soil blowing and water erosion, increase the intake of water, and maintain fertility and soil structure. Planting legumes and returning all crop residue both help to maintain soil structure and fertility and to increase the intake of water. Soil blowing can be controlled by stripcropping crosswise to the direction of the prevailing wind. Crops on this soil respond well to added fertilizer if other management is good. Seedbeds should be prepared late in spring or near planting time. Changing the depth of tillage each year helps to prevent the formation of plowpans.

CAPABILITY UNIT IVe-4

In this unit are deep, gently sloping to sloping, loamy soils of the uplands. The subsoil of all except the Dill soils contains more clay than the surface layer. These moderately eroded soils are subject to soil blowing and water erosion.

Small grains and sorghums are suited to these soils, but row crops should not be grown. Winter wheat is the principal crop.

A suitable cropping system consists of continuous sown crops. A mixture of a small grain and a legume, such as rye and vetch, can be grown year after year if all crop residue is returned to the soil. The legume in the cropping system can be omitted if fertilizer is added. All drains should be kept in perennial plants.

Practices are needed that control rapid runoff and protect these soils from soil blowing and water erosion. Also needed are practices that maintain fertility and soil structure. The soils in this unit should be terraced and farmed on the contour. Planting legumes, returning crop residue to the soil, and stubble mulching help to increase the intake of water and to maintain soil structure and fertility. Changing the depth of tillage each year helps to prevent the formation of plowpans.

CAPABILITY UNIT IVe-5

Only Renfrow-Vernon complex, 3 to 5 percent slopes, eroded, is in this unit. This complex is in the uplands and consists of deep to shallow soils. These soils are droughty and have very slow permeability. They have a moderately fine textured surface layer and a fine textured subsoil that grades to layers of clay and shale.

The soils in this complex are not well suited to cultivation, though most cultivated areas are used for small grains. Wheat is the principal crop, but other small grains, sorghums, and legumes are suitable. Growing row crops is not advisable.

A suitable cropping system consists of 6 years of crops that produce large amounts of residue followed by 2 years of soil-depleting crops. Examples of crops that produce much residue are winter wheat and sorghums; sorghums harvested for silage are soil-depleting crops. Under this system, the soils should be terraced and contour farmed. Also, all crop residue should be returned to the soil and fertilizer added.

Practices are needed that improve fertility and control rapid runoff and water erosion. Planting Austrian winter peas, sweetclover, and other legumes helps to improve fertility and to increase the intake of water. Holding as much rainfall as possible on the soil helps to prevent erosion and allows extra moisture to be stored for use by crops. Changing the depth of tillage each year helps to prevent the formation of plowpans.

CAPABILITY UNIT IVe-6

In this unit are deep, gently sloping to sloping soils of the uplands. These soils have a fine sandy loam surface layer and a moderately fine to moderately coarse textured subsoil. They are easily tilled and have low natural

fertility. Runoff is rapid. Tilled areas are subject to moderate to severe water erosion and to moderate soil blowing. Fields left bare or improperly cultivated are subject to severe soil blowing.

The soils of this unit are used mainly for winter wheat and other small grains, but sorghums and legumes are also suitable. Row crops should not be grown.

A suitable cropping system consists of 3 years of a small grain, then 1 year of a soil-depleting crop, such as sorghum used for silage, and then 1 year of a legume. Another suitable system consists of sown crops one-half of the time and legumes one-half of the time with stripcropping, stubble mulching, and contour farming.

Practices are needed that control soil blowing and water erosion. Soil blowing can be controlled by leaving all crop residue on the surface, by stubble mulching, and, where feasible, by stripcropping crosswise to the direction of the prevailing wind. Preparing seedbeds should be delayed until nearly planting time. Terracing and contour farming are needed to prevent the accumulation of water. All natural drains should be kept in perennial plants.

CAPABILITY UNIT IVe-7

This unit consists of deep, sandy, undulating, or hummocky soils of the uplands. The surface layer is fine sand or loamy fine sand, and the subsoil is moderately coarse textured.

The soils of this unit are friable, are easily tilled, and have low natural fertility. Their water intake is moderate to moderately rapid, but their water-holding capacity is low. These soils are subject to moderate water erosion and soil blowing. Soil blowing is greatest in spring.

Grain sorghums and legumes are suited to the soils in this unit, but row crops should not be grown.

In one suitable cropping system, a sown crop is grown year after year and a stubble mulch, minimum tillage, and adequate fertilizer are used. A mixture of rye and vetch seeded year after year is also suitable, and it provides good grazing and excellent cover during spring and winter.

Practices are needed that control water erosion and soil blowing. Soil blowing can be controlled by stripcropping crosswise to the direction of the prevailing wind. Fertility can be maintained or increased by planting legumes and grasses and by returning crop residue to the soil. If other management is good, crops respond well to added fertilizer. Seedbeds should be prepared late in spring or near planting time, and natural drains should be kept in perennial plants.

CAPABILITY UNIT IVw-1

Only Lela clay, wet, is in this unit. It is a deep, fertile, nearly level soil on bottom lands. Drainage is somewhat poor, and runoff and permeability are very slow.

This soil is moderately well suited to small grains and to grasses. Crops of small grain are occasionally damaged or lost as a result of flooding or a high water table. In seasons when the average rainfall is less than normal, alfalfa grows fairly well.

A suitable cropping system consists of 6 years of small grains, usually winter wheat, followed by 2 years of legumes and grasses. Soil-depleting crops should not be grown more than 2 consecutive years, and row crops should not be grown at all. Returning crop residue to the soil is a good practice.

Surface drainage is needed but is not feasible because this soil is in low-lying areas. It should be seeded to tame or native grasses and used for grazing.

CAPABILITY UNIT IVw-2

In this unit are soil complexes that consist of deep, nearly level soils and slickspots on bottom lands. The surface layer of the soils is clay or fine sandy loam, and the subsoil is fine textured to medium textured. Slickspots make up 10 to 30 percent of the total acreage and are most noticeable in cultivated fields.

Small grains, sorghums, cotton, and some alfalfa are generally grown on the soils in these complexes, but near failure of crops is common on the slickspots.

The slickspots are farmed in about the same way as soils adjacent to them. They can be improved by adding 3 to 5 tons of gypsum per acre and leaving the treated areas untilled for 2 years. Another treatment is 3 or 4 tons of cotton burs, straw, or hay and 20 pounds of nitrogen per acre.

CAPABILITY UNIT Vw-1

Only Wet alluvial land is in this unit. This land type occurs in small, nearly level areas along the North Canadian and South Canadian Rivers. It is frequently flooded. Normally, the water table is high, and water from seepage is at or near the surface. Drainage of this nearly level land is nearly impossible.

All the acreage of this land is used for native range or as wildlife habitat. Yields of forage are good. In some places, pit ponds are dug to provide water for livestock.

CAPABILITY UNIT Vw-2

Only Broken alluvial land is in this unit. This land type consists of loamy alluvium. It occurs on the banks and in the channels of streams. Slopes range from 5 to 20 percent. Because of steepness and frequent flooding, this land has little value for farming.

The native vegetation consisted of cottonwood, elm, and a few oak trees and an undergrowth of shade-tolerant shrubs, grasses, and weeds. Where the trees are in dense stands, grass does not grow well. In the more open areas, however, the principal grasses are switchgrass, Canada wildrye, western wheatgrass, and big and little bluestem. Stands of these grasses can be improved by thinning the trees or by clearing.

Broken alluvial land can be used for grazing, for recreational purposes, and as wildlife habitat.

CAPABILITY UNIT Vs-1

Only Clayey saline alluvial land is in this unit. This land type consists of deep, clayey alluvium that is compact, fine textured, and very slowly permeable. In many places it is saline. Slopes are generally less than 1 percent.

Only a few small areas are now tilled, but some areas have been tilled and abandoned and are now in native grasses. Because this land has a high content of clay, it is difficult to till and produces low crop yields. Salinity ranges from moderate to strong.

In managing this land, the main concerns are wetness, droughtiness, very slow permeability, and salinity. Erosion generally is not a hazard, but flooding occurs in some places.

This land can be used for grazing and as wildlife habitat.

CAPABILITY UNIT VIe-1

Only Sandy broken land is in this unit. This land type is deep and coarse textured. Slopes are steep and very steep, and beds of shale and clay are at a depth of 4 to 10 feet.

This land is not suitable for cultivation. It supports a dense stand of blackjack oak trees and a sparse stand of native grasses. It is suitable for grazing and as wildlife habitat.

CAPABILITY UNIT VIe-2

Albion soils, 5 to 12 percent slopes, is the only mapping unit in this capability unit. These are deep loamy soils of the uplands.

Because slopes are strong and erosion is a hazard, these soils are not suitable for cultivation. All the acreage is used for native grass range and wildlife habitat.

CAPABILITY UNIT VIe-3

Only Breaks-Alluvial land complex is in this unit. This complex occupies the short, steep side slopes and narrow strips of alluvium along drainageways. In some places the stream channel has been cut through the alluvium into the underlying red beds.

Nearly all the acreage of this complex is used for grazing. Good range management is needed to protect this land from water erosion and soil creep.

CAPABILITY UNIT VIe-4

Only Nobscot fine sand, rolling, is in this unit. It is a deep, wooded soil on sloping to moderately steep sandhills. Slopes range from 5 to 20 percent. This soil generally is not eroded, but it is subject to moderate to severe soil blowing and water erosion where its natural cover has been removed.

This soil is not suited to cultivation. All of it is in trees and native grasses and is used for range and as wildlife habitat.

CAPABILITY UNIT VIe-5

This unit consists of deep, loamy, steep soils and of loamy sloping land that formerly was cultivated but now is severely eroded.

The soils in this unit are not suitable for cultivation. In places the Minco soil supports a good stand of little bluestem, sand bluestem, and blue grama. The Eroded loamy land in this unit supports only a stand of native grasses, and that is sparse and of poor quality. All areas ought to be reseeded to desirable native grasses. The main uses are for range and wildlife habitat.

CAPABILITY UNIT VIe-6

Only Quinlan-Woodward loams, 5 to 20 percent slopes, is in this unit. These shallow and moderately deep soils of the uplands are generally moderately steep. They border broken drainageways and canyons where thick, soft, red sandstone is exposed.

These soils are not suitable for cultivation. The principal grasses on them are little bluestem, sand bluestem, and sideoats grama. These soils are used for native range, for recreational purposes, and as wildlife habitat.

CAPABILITY UNIT VIIe-1

Only Tivoli fine sand, rolling, is in this unit. It is a deep, sandy soil on long, broken, high ridges of sandhills along the north side of the North Canadian River.

This soil is rapidly permeable. It is subject to soil blowing unless protected by an adequate cover of native plants. It is covered by a sparse stand of coarse grasses and sagebrush, and there are a few elm and cottonwood trees.

All of this soil is in range that consists of sand bluestem, little bluestem, and tall dropseed. Soil blowing is reduced if areas of this soil are fenced and grazing is controlled.

CAPABILITY UNIT VIIs-1

This capability unit consists of shallow soils, rock outcrops, and land that is rough and broken. The land types are very prominent in the landscape. The shallow soils and rock outcrops occur in the southwestern part of the county along the South Canadian River; the land that is rough and broken crosses the county diagonally about 5 miles east of Watonga.

These soils and land types have little or no native vegetation. They are used for grazing, for recreational purposes, and as wildlife habitat.

CAPABILITY UNIT VIIs-2

This unit consists of one soil group, Vernon soils and Rock outcrop. The Vernon soils are shallow and consist of clay that is very slowly permeable. They are on sloping to moderately steep, broken slopes along small drains, where narrow strips of fine-textured alluvium are cut into odd-shaped patterns by shallow, dry streambeds. Rock outcrop consists of shale, sandstone, dolomite, and gypsum.

Vernon soils and Rock outcrop are prominent, for they break sharply from adjacent soils. Practices are needed to control the rapid runoff and water erosion and to increase the low intake rate and storage of water. All the acreage is used for grazing and as wildlife habitat.

Yield Predictions

Predicted yields of the principal crops grown on the soils in capability classes I, II, III, and IV are shown in table 2. Predictions were not made for the soils that are not normally suitable for cultivated crops. Crop failures, or years of no yield, are included in the yield averages.

These predictions are based on the records of the Oklahoma Agricultural Experiment Station on fertility studies, crop variety tests, and crop rotation and tillage trials that apply to the soils of Blaine County. These data have been compiled through many years on plots at the station and on farms.

Other yields at specified levels of management were obtained by the soil scientists during the survey through talking with farmers and by observation. If sufficient data were not available for a particular soil, predictions were made by comparing that soil to a similar soil on which data for several years were available. The yield

predictions extend over a period long enough to include many wet and many dry years. The yields are considerably higher during favorable years and lower during unfavorable years. These predictions can be used by farmers to determine the long-term average yields to be expected from each soil.

Yields are predicted in table 2 under two levels of management. The yields in columns A are those obtained under customary management; yields in columns B are those obtained under improved management.

Customary management is the management followed by many farmers in the county. Normally, it includes the following practices: (1) Using the proper rates of seeding, dates of planting, and methods of harvesting; (2) controlling weeds, insects, and diseases; (3) using terraces and contour farming where needed; (4) using little fertilizer, except on cash crops and when planting legumes; and (5) using mainly a one-way moldboard plow.

Improved management includes the first four practices listed in the preceding paragraph and also the following: (1) Using the kind and amount of fertilizer indicated by soil tests; (2) planting improved varieties of adapted crops; (3) using cover crops on sandy soils susceptible to blowing; (4) using drainage where needed; and (5) using special practices and tillage needed to prevent erosion, maintain soil structure, increase infiltration, and encourage the emergence of seedlings.

Specific soil conservation practices are suggested for each soil in the subsection "Management of Soils by Capability Units." Information about the use of fertilizer and lime can be obtained through the local office of the Soil Conservation Service and the county agricultural agent.

Tame Pasture

Many livestock farmers and ranchers in the county use tame pasture profitably. For many years they have been making advances in year-round grazing. Now about 16,000 acres in the county is used for tame pasture. Most of this pasture is on bottom lands consisting of Port, Dale, and Canadian soils and in uplands consisting of Vanoss and Shellabarger soils.

Grass, an economical food for livestock, is the basic plant in all permanent tame pasture. In this county most tame pasture consists of bermudagrass on the bottom lands and weeping lovegrass on the uplands. High yields are maintained by improved management that includes a systematic use of fertilizer.

A mixture of legumes and grasses is preferred for grazing because grasses are generally high in carbohydrates and legumes are high in protein, calcium, and phosphorus. A suitable mixture for Blaine County is 50 to 80 percent grass and 20 to 40 percent legumes.

In most of the county, low rainfall restricts the use of legumes to alfalfa and sweetclover. Where legumes are not used, the production of forage is maintained by adding nitrogen fertilizer. Two smaller applications at different times are preferable to one large application on moderately coarse textured soils such as the Shellabarger.

Tame pastures can be kept profitable by using good management. Good management includes proper grazing, controlling brush and weeds, and fertilizing. Fertilizer should be added according to the plant needs, soil tests, and the production level desired by the farmer or rancher.

Use of Soils for Range[3]

Range consists of native grassland that includes wooded areas used primarily for grazing. In Blaine County rangeland occupies about 237,700 acres, or about 40 percent of the total farmland. Most of the rangeland is on farms or ranches that produce both crops and livestock. A few ranges, however, are used only for the grazing of livestock.

The main objectives of range management are maintaining the ranges that are in good and excellent condition and improving those that are in fair and poor condition. The operator can always expect, however, to have small areas that are in fair or poor condition because of heavy use. He should endeavor to keep such areas as small as possible and limited to sites where soil erosion is least likely to occur. If these objectives are attained, a high net income should be provided, though the ranges in poor condition may require some difficult adjustments in use and management.

Changes in range condition generally are gradual, and the signs that the vegetation is becoming less healthy can be easily misunderstood or overlooked. For example, growth encouraged by favorable rainfall sometimes leads the operator to believe that the range is improving when the long-time trend is actually toward less desirable plants and lower yields. On the other hand, a range having the proper plant composition may appear to be in poor condition because of drought or overuse. Under normal conditions of use and moisture, this range improves rapidly and gives quick returns for improved management.

A convenient way of discussing the use of soils for range is by range sites and the condition of these sites, as indicated by their plant composition.

Range sites and condition classes

A range site is a distinctive kind of rangeland that is sufficiently uniform in climate, soil, and elevation to produce a particular kind of climax vegetation and to be significantly different from other rangeland in stocking rate and in other range practices. In the same pasture areas, several range sites often occur, and these require different management practices. These practices include fencing, locating salting and watering places, determining the period of grazing, deciding on the number and kinds of livestock, and controlling brush.

The soils of any one range site produce about the same kind and amount of climax vegetation. *Climax vegetation* is the combination of plants that grew originally on the site. It is generally the most productive vegetation for the site. This combination of plants grew well under conditions of the site and under grazing by game animals.

On sites where grazing is intense, important changes in the kinds and amount of vegetation take place. Continuous excessive grazing alters the original plant cover and lowers productivity. The livestock seek out the more palatable and nutritious grasses, and under heavy graz-

[3] By C. E. KINGERY, range conservationist, Soil Conservation Service.

TABLE 2.--PREDICTED AVERAGE ACRE YIELDS OF PRINCIPAL

[Yields in columns A are those obtained under customary management; yields in columns B grown at the level of management specified or the soil is not suited to the

Soil	Wheat		Oats	
	A	B	A	B
	Bu.	Bu.	Bu.	Bu.
Bethany silt loam, 0 to 1 percent slopes	20	30	35	50
Canadian fine sandy loam	20	28	28	38
Carwile-Shellabarger complex, 0 to 2 percent slopes	13	13	22	30
Dale silt loam	22	31	35	50
Dill fine sandy loam, 0 to 1 percent slopes	15	21	25	35
Dill fine sandy loam, 1 to 5 percent slopes	12	17	20	30
Dill fine sandy loam, 5 to 8 percent slopes	9	13	16	22
Dill fine sandy loam, 5 to 8 percent slopes, eroded	8	11	15	20
Farnum fine sandy loam, 0 to 3 percent slopes	16	26	25	34
Grant silt loam, 1 to 3 percent slopes	16	24	30	42
Grant silt loam, 3 to 5 percent slopes	14	20	24	35
Grant silt loam, 5 to 8 percent slopes	11	16	20	30
Grant silt loam, 4 to 8 percent slopes, eroded	10	14	17	26
Kingfisher silt loam, 0 to 1 percent slopes	21	30	32	42
Kingfisher silt loam, 1 to 3 percent slopes	15	26	28	38
Kingfisher-Grant silt loams, 3 to 5 percent slopes	13	23	24	34
Kingfisher-Lucien complex, 4 to 8 percent slopes, eroded	9	13	18	26
Kingfisher-Slickspots complex, 1 to 3 percent slopes	11	16	22	32
Kirkland silt loam, 0 to 1 percent slopes	14	22	30	45
Konawa loamy fine sand, undulating	11	18	22	32
Konawa loamy fine sand, hummocky	7	13	18	26
Lela clay, wet	12	17	26	34
Lela, wet-Slickspots complex	10	14	22	30
Leshara-Slickspots complex	10	15	22	30
Lincoln loamy fine sand	12	19	24	32
McLain silty clay loam	25	33	28	40
Miles fine sandy loam, 1 to 3 percent slopes	13	18	22	30
Miles fine sandy loam, 3 to 5 percent slopes	11	15	18	25
Minco loam, 0 to 1 percent slopes	22	30	28	40
Minco loam, 1 to 3 percent slopes	18	26	26	36
Minco loam, 3 to 5 percent slopes	16	24	24	32
Minco very fine sandy loam, 3 to 8 percent slopes	15	20	20	28
Nobscot fine sand, undulating	--	--	--	--
Nobscot fine sand, hummocky	--	--	--	--
Norge loam, 0 to 1 percent slopes	16	26	30	45
Norge loam, 1 to 3 percent slopes	14	23	25	40
Norge loam, 3 to 5 percent slopes	12	20	22	35
Norge loam, 5 to 8 percent slopes	9	14	17	30
Norge-Slickspots complex, 0 to 3 percent slopes	11	17	22	35
Port clay loam	22	30	40	55
Port loam	22	30	40	55
Pratt loamy fine sand, undulating	12	17	20	30
Pratt loamy fine sand, hummocky	--	--	--	--
Reinach very fine sandy loam	20	29	35	50
Renfrow silty clay loam, 0 to 1 percent slopes	16	24	30	40
Renfrow silty clay loam, 1 to 3 percent slopes	14	21	25	35
Renfrow-Vernon complex, 3 to 5 percent slopes, eroded	10	13	18	25
Shellabarger fine sandy loam, 0 to 3 percent slopes	14	21	24	36
Shellabarger fine sandy loam, 3 to 5 percent slopes	12	18	20	30

See footnote at end of table.

DRYFARMED CROPS UNDER TWO LEVELS OF MANAGEMENT

are to be expected under improved management. Absence of yield indicates crop is not commonly crop. Soils and other mapping units not suitable for cultivation are not listed]

Grain sorghum		Forage sorghum		Cotton (lint)		Alfalfa		Bermudagrass			
								Common		Improved	
A	B	A	B	A	B	A	B	A	B	A	B
Bu.	Bu.	Tons	Tons	Lbs.	Lbs.	Tons	Tons	A.U.M. 1/	A.U.M. 1/	A.U.M. 1/	A.U.M. 1/
30	44	2.2	3.2	290	375	1.5	2.5	3.0	5.0	4.0	6.2
28	40	2.5	3.5	315	400	2.2	3.0	4.5	6.5	6.0	8.0
22	32	1.5	2.2	---	---	---	---	2.8	4.8	3.5	5.5
32	45	3.2	4.0	380	450	2.6	3.6	4.5	6.5	6.0	8.0
24	32	2.4	2.8	225	290	1.0	2.0	2.8	4.0	3.2	4.8
20	24	1.6	2.2	175	240	---	---	2.5	3.5	3.0	4.4
--	--	1.2	1.8	---	---	---	---	2.0	3.0	2.6	4.0
--	--	1.0	1.7	---	---	---	---	---	---	---	---
35	48	2.2	3.0	275	350	1.8	2.6	4.0	5.5	5.0	6.2
26	36	2.4	3.2	300	375	1.5	2.3	3.0	5.4	3.8	6.0
22	35	2.0	2.7	230	300	---	---	2.8	4.8	3.5	5.5
17	25	1.2	2.0	---	---	---	---	2.5	4.0	3.0	4.8
--	--	1.0	1.8	---	---	---	---	2.0	3.2	---	---
35	48	2.2	3.2	300	375	1.7	2.5	3.5	5.5	4.2	6.5
26	38	2.0	3.0	265	340	1.2	2.8	3.0	5.4	3.8	6.0
24	33	1.8	2.6	200	275	---	---	2.8	4.8	3.5	5.5
--	--	1.2	1.8	---	---	---	---	---	---	---	---
17	26	1.5	2.2	150	200	---	---	---	---	---	---
20	28	2.0	2.8	235	290	---	---	2.0	3.5	2.5	4.0
20	30	1.8	2.8	175	275	1.0	2.0	2.0	4.5	3.5	5.5
14	22	1.2	2.2	---	---	---	---	1.8	4.0	3.2	5.0
15	23	---	2.0	175	250	---	---	3.0	4.0	3.5	5.0
15	20	1.5	2.0	150	200	---	---	2.0	3.5	3.0	4.5
15	21	1.5	2.0	150	200	---	---	2.0	3.5	3.0	4.5
20	35	1.5	2.0	---	---	---	---	3.0	3.8	3.5	5.2
40	50	2.2	3.0	325	450	3.0	4.0	4.5	6.5	6.0	8.0
20	30	2.0	2.6	200	275	---	---	3.0	4.8	3.8	5.5
18	25	1.5	2.2	150	225	---	---	2.8	4.0	3.2	5.2
30	45	2.5	3.5	300	400	2.0	3.0	4.0	5.8	5.0	6.5
26	40	2.2	3.0	275	350	1.2	2.2	3.5	5.5	4.5	6.2
22	38	2.0	2.6	225	300	---	---	3.0	5.0	4.0	5.8
--	--	---	---	---	---	---	---	2.8	4.8	3.0	5.5
10	18	1.0	1.8	---	---	---	---	---	---	---	---
--	--	1.0	1.8	---	---	---	---	---	---	---	---
38	43	2.5	3.5	300	390	1.8	2.8	4.0	5.8	5.0	6.5
30	40	2.3	3.3	275	365	1.5	2.5	3.5	5.5	4.5	6.2
23	36	2.0	2.8	210	300	---	---	3.0	5.0	4.0	5.8
--	--	---	---	---	---	---	---	2.5	4.8	3.8	5.5
20	31	1.8	2.2	160	225	---	---	---	---	---	---
40	55	3.0	4.0	340	450	2.8	3.8	4.5	6.5	6.0	8.0
40	55	3.0	4.0	340	450	2.8	3.8	4.5	6.5	6.0	8.0
18	25	2.0	2.5	150	200	---	---	2.5	4.0	3.0	4.8
--	--	1.5	2.0	---	---	---	---	---	---	---	---
30	45	3.2	4.0	380	440	2.5	3.5	4.5	6.5	6.0	8.0
20	28	1.6	2.5	225	275	---	---	2.0	3.5	2.5	4.0
16	24	1.4	2.0	160	240	---	---	2.0	3.4	2.4	3.8
--	--	---	---	---	---	---	---	---	---	---	---
28	38	2.0	2.8	250	350	1.4	2.2	3.5	5.5	4.0	6.2
20	29	1.5	2.5	175	250	---	---	3.0	4.8	3.5	5.8

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TABLE 2--PREDICTED AVERAGE ACRE YIELDS OF PRINCIPAL

Soil	Wheat		Oats	
	A	B	A	B
	Bu.	Bu.	Bu.	Bu.
Shellabarger-Teller fine sandy loams, 5 to 8 percent slope slopes	10	14	18	25
Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes, eroded	8	12	16	23
St. Paul silt loam, 0 to 1 percent slopes	18	24	28	40
St. Paul silt loam, 1 to 3 percent slopes	15	21	25	35
Tabler silty clay loam	15	26	30	40
Teller fine sandy loam, 1 to 3 percent slopes	14	22	26	38
Teller fine sandy loam, 3 to 5 percent slopes	13	19	20	32
Vanoss loam, 0 to 1 percent slopes	20	32	35	50
Vanoss loam, 1 to 3 percent slopes	16	25	30	45
Vernon clay loam, 1 to 3 percent slopes	10	15	17	25
Vernon clay loam, 3 to 5 percent slopes	8	11	15	20
Wann soils	12	18	20	30
Yahola loam	16	22	26	38

1/ An animal-unit-month is the number of months during a year that 1 acre will provide grazing for 1 animal, or 1,000 pounds of live weight; or it is the number of months times the animal units. For example, 1 acre of improved bermudagrass on Dale silt loam under customary management will provide grazing for 3 animals for 2 months during the year and is rated 6 animal-unit-months.

ing these choice plants, or *decreasers*, are weakened and gradually eliminated. The choice plants are replaced by less palatable plants, or *increasers*. If heavy grazing continues, even these increasers are weakened and the site is eventually occupied by less desirable grasses and weeds, which are called *invaders*.

The downward trend in range vegetation is generally systematic under heavy grazing and can be expressed as range condition. Four classes of range condition are recognized, *excellent*, *good*, *fair*, and *poor*. On range in excellent condition, 76 to 100 percent of the plant cover consists of the original vegetation. In good condition, the range has 51 to 75 percent of the original vegetation that grew on the site. On range in fair condition, 26 to 50 percent is that originally on the site; and on range in poor condition, 25 percent or less of the original, or climax, vegetation remains. On a range in poor condition, the vegetation consists mainly of increasers and invaders.

Small pastures, locally called stomp lots, are used on many wheat farms as holding areas for livestock until these animals can be moved to areas of wheat or sudangrass or to another temporary pasture. On these pastures are native grasses that frequently are severely overgrazed. These small pastures typically are 20 to 50 acres in size, and they have been compacted by the trampling of livestock. Normally, they do not have plant cover sufficient to hold much moisture or to slow runoff during periods of heavy rainfall.

Small pastures of native grass respond to the same management as the larger areas, but this management does not fit well with the procedures customary on a wheat farm and therefore is difficult to practice. These small pastures can be improved by using the following practices:

1. Grazing small pastures only in winter and then along with fields of sown small grain. In this way the pasture plants can grow during summer and can be grazed when the plants are nearly dormant or dormant.
2. Determining how many animals the small pasture will carry in dry years and using a permanent herd of only that size. Stocker cattle can be used to eat the extra feed that is available in wet years.
3. Holding in reserve enough feed to last a full year. With this reserve there is no reason to overgraze the small pasture in dry years.
4. Putting cattle in fenced holding lots when they must be removed from one field before another field is ready for use.

Descriptions of range sites

The soils of Blaine County have been grouped into range sites on which the kinds and condition of climax vegetation can easily be determined. Each site is briefly discussed in the following paragraphs. To find the soils in each range site, refer to the "Guide to Mapping Units" at the back of this survey.

The predicted yield of herbage, excluding woody plants, is given for each site. Herbage production depends on the nature of the site, the condition and vigor

DRYFARMED CROPS UNDER TWO LEVELS OF MANAGEMENT--Continued

Grain sorghum		Forage sorghum		Cotton (lint)		Alfalfa		Bermudagrass			
								Common		Improved	
A	B	A	B	A	B	A	B	A	B	A	B
Bu.	Bu.	Tons	Tons	Lbs.	Lbs.	Tons	Tons	A.U.M. 1/	A.U.M. 1/	A.U.M. 1/	A.U.M. 1/
15	23	1.2	2.2	---	---	---	---	2.8	4.5	3.0	5.5
--	--	1.0	2.0	---	---	---	---	2.5	3.8	2.8	4.5
25	35	2.2	3.0	250	350	1.7	2.5	3.0	5.4	3.8	6.0
20	30	1.8	2.6	200	300	1.0	1.8	2.8	5.0	3.5	5.8
23	34	1.8	2.5	200	325	---	---	---	---	---	---
24	36	2.2	3.0	240	350	1.5	2.4	3.5	5.5	4.5	6.2
20	31	2.0	2.8	215	300	---	---	3.0	5.0	4.0	5.8
30	45	2.7	3.7	325	415	2.0	3.0	4.4	6.4	5.8	7.5
26	40	2.5	3.5	225	390	1.7	2.7	4.2	6.0	5.5	7.0
10	17	1.2	1.8	---	---	---	---	---	---	---	---
--	--	---	---	---	---	---	---	---	---	---	---
20	30	1.8	2.8	200	300	---	---	4.4	6.4	5.8	7.5
24	37	2.5	3.3	310	390	2.2	3.0	4.5	6.5	6.0	8.0

of the vegetation, and precipitation. On a given pasture, the production of herbage varies from year to year according to variations in precipitation. Successful managers allow for these variations and adjust the number of livestock to accord with the capacity of the pasture. Heavier stocking can be practiced during favorable periods of rainfall so as to take advantage of higher production of herbage. Heavier stocking generally means adding stocker cattle to the herd. During periods of unfavorable rainfall, or extended drought, the numbers of livestock must be reduced. Many operators hold in reserve enough feed to last a full year and use it to offset the effects of extended drought.

ALKALI BOTTOM LAND RANGE SITE

This site consists of soils on relatively flat bottom lands. These soils are droughty, and their water intake rate is very slow.

The vegetation that commonly grows on this site includes switchgrass, vine-mesquite, alkali sacaton, blue grama, western wheatgrass, and inland saltgrass. When this site is grazed closely, inland saltgrass commonly increases and mesquite trees often invade.

On this site the predicted yield of air-dry herbage is 3,200 pounds per acre in years of favorable moisture and 1,500 pounds in years of unfavorable moisture.

BREAKS RANGE SITE

The mapping units that make up this site consist mainly of rock outcrops and breaks of steep slopes and of canyon walls. These rough areas support a wide variety of vegetation, but they cannot be crossed by livestock in many places, or the animals must make many detours. Obtaining uniform grazing on the adjacent sites is difficult.

On this site the predicted yield of air-dry herbage is 1,800 pounds per acre in years of favorable moisture and 1,200 pounds in years of unfavorable moisture.

CLAYPAN PRAIRIE RANGE SITE

This site consists of nearly level to gently sloping soils on prairies. These soils have a clay subsoil that restricts the growth of roots and the movement of water.

When a range on this site is managed well, the principal grasses include little bluestem, big bluestem, blue grama, vine-mesquite, and sideoats grama. When the site is grazed heavily and continuously, blue grama, buffalograss, and unpalatable weeds increase.

On this site the predicted yield of air-dry herbage is 4,000 pounds per acre in years of favorable moisture and 2,000 pounds in years of unfavorable moisture.

DEEP SAND RANGE SITE

This site consists of undulating to hummocky loamy sands that lose moisture readily. These soils tend to be somewhat droughty because their permeability is moderately rapid.

A well-managed range on this site supports sand bluestem, little bluestem, indiangrass, sand lovegrass, and switchgrass and a smaller amount of woody plants. Blue grama and fall switchgrass are common increasers. Skunkbush, sand sagebrush, and sandplum, the main woody plants, increase rapidly if management is poor. On a range in poor condition, the vegetation consists

mainly of sand sagebrush, skunkbush, sand dropseed, red lovegrass, and annual wild buckwheat.

On this site the predicted yield of air-dry herbage is 3,500 pounds per acre in years of favorable moisture and 1,500 pounds in years of unfavorable moisture.

DEEP SAND SAVANNAH RANGE SITE

This site consists of moderately productive loamy fine sands and fine sands. Slopes range from undulating to hummocky or rolling. Tall grasses, trees, and brush grow well because these loose soils permit deep penetration of roots, and moisture is readily available.

The principal decreasers on this site are sand bluestem, little bluestem, switchgrass, and indiangrass. Blackjack oak, shin oak, hackberry, redbud, sumac, and many other low woody plants and trees increase rapidly if the range is misused.

On this site the predicted yield of air-dry herbage is 4,200 pounds per acre in years of favorable moisture and 1,750 pounds in years of unfavorable moisture.

DUNE RANGE SITE

This site consists of only one soil, Tivoli fine sand, rolling. It is mainly in areas of steep, choppy dunes.

This site supports big sandreed, sand bluestem, little bluestem, and many other kinds of tall grasses. Some trees, brush, and vines also grow. Soil blowing is active where animals congregate on the high, sandy ridges of dunes. Where feasible, fencing these dunes separately is desirable so that grazing can be better controlled.

On this site the predicted yield of air-dry herbage is 2,000 pounds per acre in years of favorable moisture and 1,000 pounds in years of unfavorable moisture.

HARD LAND RANGE SITE

This site consists of deep, nearly level to very gently sloping silt loams in the uplands. The water intake rate of these soils is slow, but on the nearly level and very gentle slopes much water soaks in where plant cover is thick.

The lightly grazed areas of this site support big and little bluestem, switchgrass, sideoats grama, and vine-mesquite. Livestock tend to overgraze this site because it is generally smoother and more accessible than the surrounding areas. The heavy grazing decreases the more desirable grasses rapidly, and excessive trampling compacts the soils and makes them droughty. Buffalograss, blue grama, and sideoats grama are the main increasers; silver bluestem and western ragweed are the common invaders.

On this site the predicted yield of air-dry herbage is 3,200 pounds per acre in years of favorable moisture and 1,500 pounds in years of unfavorable moisture.

LOAMY BOTTOM LAND RANGE SITE

This site consists of deep, loamy soils on bottom lands that are highly productive. The soils that are occasionally flooded are used mostly as native range; those that are less frequently flooded are generally cultivated.

The principal grasses on this site are big bluestem, sand bluestem, switchgrass, indiangrass, and little bluestem. Trees vary in number and include elm, cottonwood, hackberry, and chittamwood.

On this site the predicted yield of air-dry herbage is 8,500 pounds per acre in years of favorable moisture and 4,500 pounds in years of unfavorable moisture.

LOAMY PRAIRIE RANGE SITE

This site consists of loamy soils of the uplands. These soils are mainly nearly level to sloping, but in places they are strongly sloping to steep. Penetration of roots is deep, and the capacity for storing water is good.

This site is productive. The dominant grasses are little bluestem, sand bluestem, sideoats grama, and some blue grama. Sideoats grama and blue grama are first to increase under heavy grazing.

On this site the predicted yield of air-dry herbage is 4,500 pounds per acre in years of favorable moisture and 2,500 pounds in years of unfavorable moisture.

RED CLAY PRAIRIE RANGE SITE

This site consists of red, clayey, very gently sloping to steep soils that are shallow to bedrock. Gypsum rock, shale, and sandstone crop out in places.

Although the native vegetation on this site varies widely, the dominant grasses are mainly sideoats grama and little bluestem and, in places, some sand bluestem. Also on this site are many kinds of palatable forbs and legumes. Careful management is required to prevent overgrazing and high losses of soil and water.

On this site the predicted yield of air-dry herbage is 2,700 pounds per acre in years of favorable moisture and 1,600 pounds in years of unfavorable moisture.

SANDY BOTTOM LAND RANGE SITE

This site consists of only one mapping unit, Lincoln loamy fine sand. This deep, sandy, nearly level soil is on bottom lands and is subject to frequent flooding. It is easily penetrated by roots. In some low places, this soil is subirrigated.

The principal vegetation on this site includes switchgrass, sand bluestem, and indiangrass, but native legumes, forbs, and woody plants also occur. After this site has been flooded, it is often invaded by saltcedar and cottonwood.

On this productive site the predicted yield of air-dry herbage is 5,000 pounds per acre in years of favorable moisture and 3,000 pounds in years of unfavorable moisture.

SANDY PRAIRIE RANGE SITE

This site consists of nearly level to strongly sloping fine sandy loams that take in water well.

The principal vegetation on this site is sand bluestem and little bluestem. Sand sagebrush, sandplum, and other woody plants occur in places and tend to increase under heavy grazing.

On this productive site the predicted yield of air-dry herbage is 4,500 pounds per acre in years of favorable moisture and 2,000 pounds in years of unfavorable moisture.

DEEP SAND SAVANNAH-BREAKS RANGE SITE

This site consists of one mapping unit, Sandy broken land. It is in moderately steep, broken drainageways that are wooded in most places.

On this site the trees are mainly oak and redcedar, and the most abundant grasses are little bluestem and sand

bluestem. Careful management that reduces runoff and erosion is needed.

On this site the predicted yield of air-dry herbage is 2,500 pounds per acre in years of favorable moisture and 1,000 pounds in years of unfavorable moisture.

SHALLOW PRAIRIE RANGE SITE

This site consists of shallow, sloping to moderately steep soils. Generally, the vegetation includes sideoats grama, hairy grama, little bluestem, rough tridens, and blue grama.

This site is moderately productive. The predicted yield of air-dry herbage on this site is 3,000 pounds per acre in years of favorable moisture and 1,500 pounds in years of unfavorable moisture.

SLICKSPOT RANGE SITE

This site consists of slickspots that occur in the uplands with the Loamy Prairie range site. These slickspots crust on the surface and in most places are somewhat saline.

The vegetation is principally blue grama, alkali sacaton, inland saltgrass, and switchgrass. Inland saltgrass is the main increaser.

On this site the predicted yield of air-dry herbage is 1,800 pounds per acre in years of favorable moisture and 700 pounds in years of unfavorable moisture.

SUBIRRIGATED RANGE SITE

This site consists of soils on bottom lands that have either a clay or sandy clay substratum. This substratum holds the water table within reach of plant roots.

The soils of this site contain some salts that favor the growth of the more salt-tolerant grasses. These grasses are switchgrass, Canada wildrye, prairie cordgrass, eastern gramagrass, and alkali sacaton. Abuse of this site results in the increase of and invasion by inland saltgrass, alkali muhly, silver bluestem, and other poor grazing plants.

The predicted yield of air-dry herbage on this site is 7,500 pounds per acre in years of favorable moisture and 4,000 pounds in years of unfavorable moisture.

Use of Soils for Windbreaks and Post Lots [4]

Cottonwood, willow, and tamarisk are dominant along the main streams, mainly along the North Canadian and South Canadian Rivers and their many tributaries. The number of cottonwoods gradually decreases along the tributaries as the number of elm, hackberry, soapberry, coffeetree, and associated species increases. Redcedar is common in the canyonlike upper reaches of the tributaries, and in some places it tends to invade range or idle land.

The Nobscot soils developed on the sandy uplands under a forest of post oak and blackjack oak, and much of their acreage remains in the original cover or has reverted to it after cultivation was attempted. Redcedar is gradually becoming established along with the oaks.

Mesquite is a common invader on a rough, escarpmentlike band of Vernon and Lucien soils that crosses the county in a northwest-southeast direction. Along the western boundary of this band, redcedar, elm, and hackberry grow in some of the deep canyons. A similar but smaller area is along the South Canadian River in the extreme southwestern part of the county.

Rough lumber from post oak, bur oak, elm, and cottonwood has been used extensively in the county. In the less accessible areas, timber left after earlier cutting is now being logged and hauled to portable sawmills. Redcedar, post oak, and coffeetree are in moderate use for fenceposts, and black walnut logs of small diameter are readily marketed outside the county. Also useful in the county are trees and shrubs planted in windbreaks that protect fields and farmsteads.

The soils of Blaine County have been placed in four woodland suitability groups, as shown in the "Guide to Mapping Units" at the back of this survey. The soils in groups 1, 2, and 3 are suitable for trees and shrubs, but the soils in group 4 are not, mainly because they are saline, eroded, or shallow. Following are descriptions of the four groups.

WOODLAND SUITABILITY GROUP 1

In this group are deep, nearly level to gently sloping soils of the uplands and bottom lands. These soils are all well drained and all have moderate moisture-holding capacity, except the McLean soil which has high moisture-holding capacity. Runoff is slow.

The soils in this group are good to excellent for growing trees in windbreaks and in post lots. An exception is the Carwile soil in the Carwile-Shellabarger complex, 0 to 2 percent slopes. The Carwile soil is rated fair for windbreaks, but it is not suited as a post lot.

Tall trees suitable for windbreaks on the soils of this group are Siberian elm, cottonwood, and sycamore. The elm grows best on the loams and fine sandy loams and may grow to a height of 70 feet in 20 years. Cottonwood and sycamore grow better on the sandier soils, particularly those soils having a high water table. Cottonwood grows to a height of 70 to 80 feet in 20 years, but sycamore rarely exceeds 70 feet in that period.

Russian mulberry is a low tree or high shrub that can be used in windbreaks as an understory with cottonwood and sycamore. When spaced about 4 feet apart in rows, this mulberry makes an excellent shrub.

Austrian pine, ponderosa pine, eastern redcedar, and some strains of seedling (nongrafted) Chinese arborvitae are evergreens suitable for windbreaks. These evergreens can be used either as the tall trees of a windbreak or as the lower trees in front of the tall trees. Austrian pine and ponderosa pine seldom grow to a height of more than 26 to 30 feet in 20 years; redcedar and arborvitae generally average about 30 feet in that period.

Black locust, catalpa, and Osage-orange grow well on the soils of this group and are commonly used for posts. Osage-orange is better suited to Port clay loam, Port loam, and other finer textured soils. All three species produce an average of six posts per tree at 20 years of age. More posts can be produced, however, if the trees are selectively cut at 8 to 12 years of age and the sprouts from their stumps are managed for future posts.

[4] By HERBERT R. WELLS, woodland conservationist, Soil Conservation Service.

WOODLAND SUITABILITY GROUP 2

In this group are deep, nearly level to sloping or hummocky soils that range from medium to coarse in texture. These soils are generally well drained, but some are somewhat excessively drained.

The soils in this group are fair to good for growing trees in windbreaks and in post lots. The exceptions are Breaks-Alluvial land complex and Broken alluvial land. Alluvial land in these mapping units is rated fair to good for growing trees and can be used for post lots, but this land generally does not occur in places where windbreaks are needed.

Tall trees suitable for windbreaks on the soils of this group—Siberian elm, cottonwood, and sycamore—are the same as those in group 1. But in the first 20 years, tall trees on these soils average 10 to 20 feet less in height because of less favorable moisture relationships in the subsoil. The height of Russian mulberry, Austrian pine, ponderosa pine, eastern redcedar, Chinese arborvitae, and other low-growing shrubs and trees on the soils of this group is generally 5 to 10 percent less than it is on soils of group 1. This percentage is about the same for black locust, catalpa, and Osage-orange, the species commonly used for posts.

WOODLAND SUITABILITY GROUP 3

The soils in this group vary widely in characteristics. They range from deep to shallow, from nearly level to sloping or hummocky, and from slightly eroded to moderately eroded. Texture ranges from clay loam to loamy fine sand. Runoff ranges from slow to very rapid, and permeability ranges from moderately rapid to very slow.

The soils in this group are fair to poor for growing trees. Their limitations make them unsuitable for growing trees in field windbreaks and in post lots. In places where great height is not needed and where the trees can be watered from the regular farm supply, trees can be grown in farmstead windbreaks. Slickspots in the Kingfisher-Slickspots complex, 1 to 3 percent slopes; Leshara-Slickspots complex; and Norge-Slickspots complex, 0 to 3 percent slopes, are generally unsuitable for trees, but they can support Siberian elm and tamarisk of sufficient height and vigor for farmstead windbreaks.

Siberian elm is the most suitable tall tree on the soils of this group. Although this tree seldom exceeds a height of 40 to 50 feet at 20 years of age, it grows rapidly during the first several years and provides early protection as a farmstead windbreak. Russian mulberry also grows rapidly during its early life, but its average height at 20 years of age is only 20 to 30 feet.

Eastern redcedar and Chinese arborvitae are suitable on these soils. Because of their evergreen foliage and long life, these trees are the most valuable ones in a windbreak after 20 years. Early growth is slow, however, and the average height of these trees at 20 years of age is only 20 to 25 feet. Austrian pine and ponderosa pine are also suitable, but growth of these evergreens is even slower.

WOODLAND SUITABILITY GROUP 4

The soils in this group range from shallow to deep, from nearly level to steep, and from slightly acid to saline. Erosion ranges from none or slight to severe. These soils occur on uplands and on bottom lands.

Mainly because of salinity, erosion, or shallowness, the soils of this group are not suitable for growing trees in windbreaks or post lots.

Wildlife and Fish [5]

The main areas of wildlife habitat in Blaine County are the prairies, the timbered uplands, and the timbered bottom lands. The prairies are in the northeastern one-third of the county; the timbered uplands are strips that parallel the North Canadian and South Canadian Rivers; and the timbered bottom lands are strips on both sides of the North Canadian River and mainly on the north side of the South Canadian River.

The important kinds of wildlife in the county are bobwhite (quail), mourning dove, fox, squirrel, deer, cottontail rabbit, jackrabbit, prairie dog, raccoon, mink, opossum, skunk, badger, and muskrat. Colonies of beaver live along the rivers. Some wild turkey of the Rio Grande species have been released in the county and appear to be increasing in number. The main predators are coyotes, bobcats, and a few foxes. Predatory birds are hawks and owls. The Mississippi kite nests in the county.

Large numbers of waterfowl are attracted to Canton Reservoir during their migration. Mallard and pintail ducks and other waterfowl fly considerable distances from this lake to feed in grainfields.

A convenient way to discuss the wildlife and its habitat in the county is by soil associations. The eight soil associations in the county are described in the section "General Soil Map" and are shown on the colored map at the back of this soil survey.

The Norge-Kingfisher-Renfrow association (1) and the Bethany-Kirkland-Tabler association (2) are in the northeastern part of the county. These associations make up about 25 percent of the county, but most of this acreage is intensively cultivated. The narrow strips along the larger streams and drainageways are suitable wildlife habitat. Here are found squirrels, rabbits, quail, raccoon, and opossum. The natural vegetation consists mostly of elm, cottonwood, bur oak, soapberry, plum, and a few species of shrubs. Giant ragweed and annual sunflower thrive along roads, banks of creeks, and in other odd areas. The limited habitat in these associations generally supports only small numbers of wildlife, but the jackrabbit population is moderate in favorable years.

The Vernon-Lucien association (3) is in two areas. The larger area crosses the county from northwest to southeast, in a band 1 to 4 miles wide. The smaller area is in the southwestern part of the county along the south bank of the South Canadian River. This association makes up about 15 percent of the county. Little of this acreage is cultivated, and the native vegetation is sparse and of limited variety. Only a thin stand of native grass grows on the flats and nearly level areas, but stands of cactus are dense. In the uplands are a few thin stands of mesquite and hackberry trees, but denser stands of cottonwood, soapberry, ash, elm, and other trees are on the bottoms of the ravines. Good habitat is provided for rodents, jackrabbits, and prairie dogs. The numerous crevices and other inaccessible areas are ideal dens for

[5] By JEROME F. SYKORA, biologist, Soil Conservation Service.

coyotes and bobcats. Several thousands of the moderate to large numbers of rattlesnakes that live in this association are captured or killed each year for sport, food, and medicinal purposes.

The Shellabarger-Nobscot-Pratt association (4) consists of two areas. One is along the east side of the North Canadian River, and the other is between that river and the South Canadian River. This association makes up about 21 percent of the county. Its combination of woodland, rangeland, and cropland provides some of the best habitat in the county for almost all kinds of wildlife. On the deep soils grow blackjack oak, cottonwood, and elm and many kinds of shrubs, including sumac, plum, and dogwood. The wildlife that eat seeds obtain much of their food from wild lespedeza, sunflower, foxtail millet, and other plants. This supply of natural food is supplemented by waste grain along the edges of the sorghum fields.

Shelterbelts have been planted for many miles on this association to control soil blowing, but a large number of these have been removed to make way for additional cropland. Those that remain are well cared for and add to the natural habitat for wildlife. They generally consist of low shrubs and trees that are tall and of medium height. Among these shrubs and trees are sandplum, desert-willow, redcedar, Osage-orange, honeylocust, black locust, and Siberian elm. Many kinds of birds and animals find food and cover in these shelterbelts.

The Canadian-Port-Lincoln association (5) lies in bands 2 to 3 miles wide on the flood plains and low benches along the North Canadian and South Canadian Rivers. This association makes up about 12 percent of the county. The soils on bottom lands are used mainly as range. These soils are deep, have a high water table, and support desirable plants that provide food and cover for many kinds of wildlife. The soils on low benches are cultivated intensively and are poor for wildlife.

The Grant-St. Paul association (6) is in the loamy, nearly level to sloping uplands on the western side of the North Canadian River. It consists of a strip between Canton and Geary that is 2 to 4 miles wide and makes up about 9 percent of the county. Because a high percentage of this association is under intensive cultivation, only a small acreage is suitable as wildlife habitat. Limited habitat of low quality is along some of the larger streams and drainageways in areas not suitable for cultivation.

The Dill-Minco-Nobscot association (7) consists of moderately deep to deep, sandy and loamy soils on very gently sloping to steep uplands. This association makes up about 11 percent of the county. It is used mainly for range, but some fairly small fields are cultivated and add to the natural food and cover for wildlife. A good combination of the open grassland, cropland, and woody cover provides some of the best wildlife habitat in the county. The woody cover consists of post oak and blackjack oak interspersed with patches of sumac, plum, shin oak, and redcedar.

The Vanoss-Minco association (8) makes up about 7 percent of the county. It consists of deep, loamy soils of the high upland terraces. Most of these soils are intensively cultivated, but along the larger streams and drainageways there are small areas of low-quality habitat suitable for quail and rabbits. Sparsely covered areas are good for jackrabbits.

Many farm ponds have been built in the county to provide water for livestock. These ponds produce moderate to good amounts of black bass and channel catfish if a reasonably stable depth is maintained by water that drains from a watershed well covered with plants. Ponds built on the more permeable or excessively drained soils, such as those of the Dill-Minco-Nobscot association (7), generally do not hold enough water for good fish production, and in drier years all the fish may be lost. Ponds are turbid most of the time if they are in areas where runoff is mainly from cultivated soils, such as those in the Norge-Renfrow-Kingfisher (1) and the Bethany-Kirkland-Tabler (2) associations. These ponds are generally not suitable for fish, though a few channel catfish and bullheads can live in them.

Engineering Uses of Soils [6]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, foundations of buildings, facilities for water storage, structures for erosion control, drainage systems, and sewage disposal systems. The properties most important to engineers are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell potential, grain size, plasticity, and reaction (pH). Depth to the water table and to bedrock and topography also are important.

The information in this soil survey can be used by engineers to—

1. Make studies of soil and land use that will aid in selecting and developing sites for industrial, business, residential, and recreational uses.
2. Make preliminary estimates of the engineering properties of soils that affect the planning of agricultural drainage systems, farm ponds (fig. 9), irrigation systems, terraces, and waterways.
3. Make preliminary evaluations of soils and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables and in planning detailed investigations of the selected locations.
4. Locate probable sources of gravel and other material used in construction.
5. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structures.
6. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

[6] By PETER A. RASMUSSEN, agricultural engineer, Soil Conservation Service.

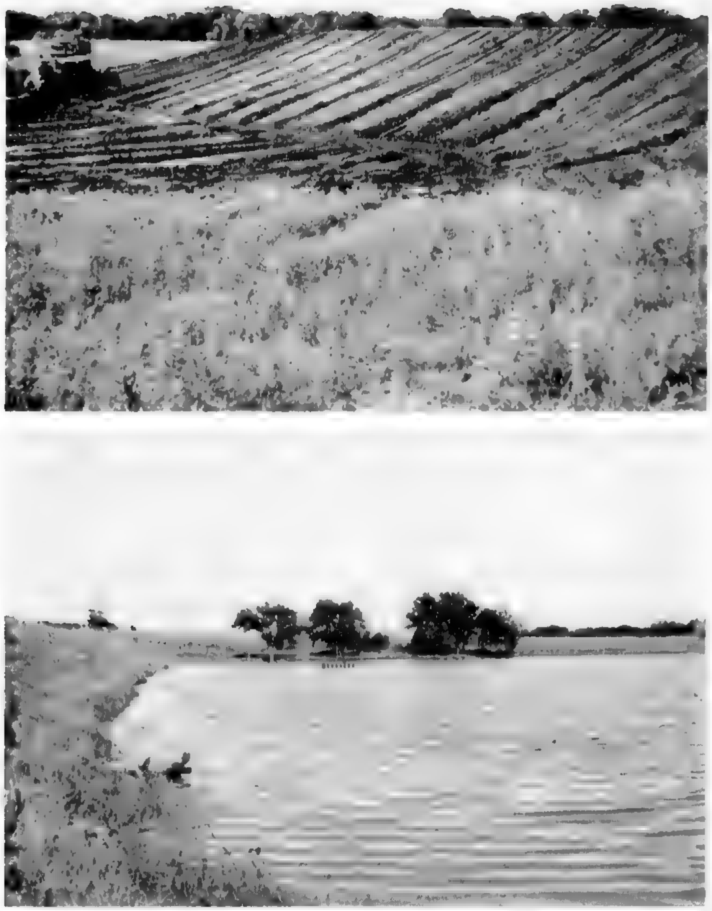

Figure 9.—Top: **Constructing a dam for a pond in Grant silt loam, 3 to 5 percent slopes.** ***Bottom:*** **Completed pond that can be used for watering livestock and wildlife and for recreational purposes. The grass-covered embankment at left is the one shown under construction.**

The engineering interpretations reported here can be useful for many purposes. It should be emphasized that they may not eliminate the need for sampling and testing at the site of specific engineering works that involve heavy loads or where the excavations are deeper than the depth of the layers reported. Even in these situations, however, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Although the detailed soil map and the tables serve as a guide for evaluating most soils, a detailed investigation is needed at the site of the proposed construction because as much as 15 percent of an area designated as a specific soil on the map may consist of areas of other soils too small to be shown on the published map. By comparing the soil description with the result of investigations at the site, the presence of an included soil can usually be determined.

Most of the information in this section is given in tables 3, 4, and 5. These tables contain a summary of soil properties significant to engineering and some engineering interpretations. Additional information useful to engineers can be found in other sections of this survey, particularly "Descriptions of the Soils" and "Classification and Morphology of Soils."

Some of the terms used by the soil scientist may not be familiar to the engineer, and some commonly used terms may have a special meaning in soil science. Several of these terms are defined in the Glossary at the back of this soil survey.

Engineering classification systems

Most highway engineers classify soil materials according to the AASHO system (*1*). In this system the soils are placed in seven basic groups, designated A–1 through A–7. In group A–1 are gravelly soils of high bearing capacity, or the best soils for road subgrade, and in group A–7 are the poorest soils, clays that have low strength when wet. Groups A–1, A–2, and A–7 can be further divided to indicate more precisely the nature of the soil material. Within each group, the relative engineering value of the soil material may be indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. Index numbers are shown in parentheses following the group symbol; for example, A–4(2).

In the Unified classification, the soils are grouped on the basis of their texture and plasticity and their performance as material for engineering structures (*7*). Soil materials are identified as gravels (G), sands (S), silts (M), clays (C), organic (O), and highly organic (Pt). Clean sands are identified by the symbols SW and SP; sands mixed with fines of silt and clay are identified by the symbols SM and SC; silts and clays that have a low liquid limit are identified by the symbols ML and CL; and silts and clays that have a high liquid limit are identified by the symbols MH and CH.

The United States Department of Agriculture classifies soils according to texture, which is determined by the proportion of sand, silt, and clay in the soil material (*3*). The terms "sand," "silt," and "clay" are defined in the Glossary at the back of this survey.

Estimated engineering properties of soils

Table 3 provides estimates of some of the properties of soils that affect engineering. The estimates are for a profile typical of each soil type. The thickness of each horizon is shown in the column headed "Depth."

Where test data are available, the estimates are based on test data for the modal, or typical profile. If tests were not performed for a soil, the estimates are based on test data obtained for similar soils in this county, or on test data obtained on that soil in other counties. Past experience in engineering is considered in the estimates. Since the estimates are only for the modal soils, considerable variation from these estimates should be anticipated. Following are explanations of some of the columns in table 3.

The available water capacity, sometimes called available moisture capacity, is the amount of water held available to plants by the soil. When the soil material is air

dry, this amount of water wets it to a depth of 1 inch but does not penetrate deeper.

Reaction is the degree of acidity or alkalinity of a soil and is expressed in terms of pH values. A pH of 4.5 or 5.0 indicates very strong acidity, and a pH of 9.1 or higher indicates very strong alkalinity.

The shrink-swell potential of a soil refers to its change in volume that results from a change in moisture content. The estimates are based on tests of volume change or on observation of physical properties and characteristics of the soils. The soil material from the B horizon of Kirkland silt loam, for example, is very sticky when wet and cracks extensively when it dries; hence, this material has a high shrink-swell potential. In contrast, the material from the A horizon of Nobscot fine sand is structureless and nonplastic and has low shrink-swell potential.

Permeability relates to the downward movement of water through undisturbed soil material and is estimated for a soil as it occurs in place. These estimates are based on soil structure and porosity. Plowpans, surface crusts, and other restrictions are considered in estimating permeability.

The verbal ratings for permeability and their numerical equivalents are as follows: Very slow, less than 0.05 inch; slow, 0.05 to 0.20; moderately slow, 0.20 to 0.80; moderate, 0.80 to 2.50; moderately rapid, 2.50 to 5.00; rapid, 5.00 to 10.00; and very rapid, more than 10.00.

A hydrologic soil group is a group of soils that have similar rates of infiltration, and when wetted, similar rates of permeability, or transmission of water within the soil. Four hydrologic groups are recognized.

Soils in group A have a high infiltration rate, even when thoroughly wet. They have a high rate of water transmission and low runoff potential. The soils of this group are deep, are well drained to excessively drained, and consist chiefly of sand or gravel, or both.

Soils in group B have a moderate infiltration rate when thoroughly wet. Their rate of water transmission and their runoff potential are both moderate. The soils in this group are moderately deep to deep, are moderately well drained to well drained, and have fine to moderately coarse texture.

The soils in group C have a slow infiltration rate when thoroughly wet. Their rate of water transmission is slow, and their potential runoff is high. These soils have a layer that impedes downward movement of water, or they are of moderately fine to fine texture and have a slow infiltration rate.

Soils of group D have a very slow infiltration rate when thoroughly wet. Their rate of water transmission is very slow, and their runoff potential is very high. In this group are (1) clay soils with a high shrink-swell potential; (2) soils with a permanently high water table; (3) soils with a claypan or clay layer at or near the surface; and (4) soils shallow over nearly impervious material.

Some soils listed in table 3 are subject to flooding, are affected by numerous slickspots, or have a high water table. These limitations affect the following soils:

Frequent flooding:
- Broken alluvial land (Br).
- Wet alluvial land (Wt).

Occasional flooding:
- Lela clay, wet (Lc).
- Leshara-Slickspots complex (Lh).
- Lincoln loamy fine sand (Ln).
- Port clay loam (Pc).

Numerous slickspots:
- Kingfisher-Slickspots complex (KlB).
- Lela, wet-Slickspots complex (Le).
- Leshara-Slickspots complex (Ln).
- Norge-Slickspots complex (NsA).

Seasonally high or perched water table:
- Lela clay, wet (Lc).
- Tabler silty clay loam (Ta).
- Wann soils (Wa).
- Wet alluvial land (Wt).

Engineering interpretations of soils

In table 4 the soils of Blaine County are rated according to their suitability as a source of topsoil, grading material, and road fill; and then those features affecting their suitability as sites for highways, farm ponds, drainage systems, terraces, and waterways are shown. The information in table 4 is based on the actual test data in table 5 and on field experience.

Some soils in the county contain sand or gravel at variable depths, but none are dependable as a source of sand or gravel and therefore have not been rated.

The suitability of select grading material depends primarily on the grain size and the content of silt and clay. Soils that consist chiefly of sand are good grading material if confined or if a binder is added that increases cohesion. Clay soils, in contrast, are compressed under load but rebound when unloaded and for this reason are poor grading material.

Road fill can be most any kind of soil material. Sandy clays, sandy clay loams, and other sandy soils offer few problems in placement or compaction. Clays with a high shrink-swell potential, however, require special compaction and close moisture control both during and after construction. Sands compact well but are difficult to confine in a fill. The ratings in table 4 reflect the various limitations and advantages of the different kinds of soil materials.

Test data

Table 5 contains test data on seven selected soils. The samples were collected during the survey of Blaine County and were tested by the Oklahoma Department of Highways. The results of these tests are reported in table 5 in common engineering terms, some of which are explained in the following paragraphs.

As moisture is removed, the volume of soil decreases in direct proportion to the loss of moisture until a condition of equilibrium, called the shrinkage limit, is reached. Beyond the shrinkage limit, more moisture may be removed, but the volume will not change. In general, the lower the shrinkage limit, the higher the content of clay. The shrinkage limit of sand that contains little or no clay is close to the liquid limit and therefore is considered insignificant. As a rule, the load carrying capacity of a soil is highest when the moisture content is at or below the shrinkage limit. Sands do not follow this rule, because sands, when confined, have a uniform load carrying capacity throughout a considerable range of moisture content.

TABLE 3.--ENGINEERING

Soil types, land types, complexes, and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Albion soils (AbE).	0-10	Sandy loam---------------	SM---------	A-2-------
	10-18	Sandy clay loam----------	SM, SC-----	A-4-------
	18-26	Sandy loam---------------	SM---------	A-2-------
	26-40	Sand---------------------	SM, SC-----	A-3-------
Bethany silt loam (BeA).	0-14	Silt loam----------------	ML, CL-----	A-4-------
	14-20	Silty clay loam----------	ML, CL-----	A-4-------
	20-60	Silty clay loam----------	CL---------	A-6, A-7--
Breaks-Alluvial land complex (Bk).	(1/)	------------------------	-----------	----------
Broken alluvial land (Br).	(1/)	------------------------	-----------	----------
Canadian fine sandy loam (Ca).	0-60	Fine sandy loam----------	SM, ML-----	A-2, A-4--
Carwile-Shellabarger complex (CsA). (Estimates are for Carwile part of mapping unit; refer to Shellabarger fine sandy loam for Shellabarger part.)	0-8	Fine sandy loam----------	SM---------	A-4-------
	8-32	Silty clay loam----------	SC, CL-----	A-6-------
	32-50	Sandy loam---------------	SM, SC-----	A-4-------
Clayey saline alluvial land (Cy).	(1/)	------------------------	-----------	----------
Dale silt loam (Da).	0-14	Silt loam----------------	ML, CL-----	A-4, A-6--
	14-70	Silt loam----------------	ML, CL-----	A-4, A-6--
Dill fine sandy loam (DfA, DfB, DfD, DfD2).	0-40	Fine sandy loam----------	SM, SM-SC--	A-4-------
	40	Sandstone.		
Eroded loamy land (Er).	(1/)	------------------------	-----------	----------
Farnum fine sandy loam (FaA).	0-12	Fine sandy loam----------	SM---------	A-2, A-4--
	12-24	Loam---------------------	ML, CL-----	A-4-------
	24-60	Silty clay loam----------	CL---------	A-6-------
Grant silt loam (GrB, GrC, GrD, GrD2).	0-12	Silt loam----------------	ML, CL-----	A-4-------
	12-52	Silty clay loam----------	ML-CL------	A-4, A-6--
	52-60	Silt loam----------------	ML-CL------	A-4-------
Kingfisher silt loam (KfA, KfB, KgC, KlB). (For properties of Grant soils in mapping unit KgC, refer to Grant silt loam; about 20 percent of mapping unit KlB consists of Slickspots.)	0-18	Silt loam----------------	ML, CL-----	A-4-------
	18-44	Silty clay loam----------	CL---------	A-6,A-7---
	44	Redbeds.		
Kingfisher-Lucien complex (KhD2). (Estimates are for Lucien part of mapping unit; refer to Kingfisher silt loam for Kingfisher part.)	0-16	Fine sandy loam----------	SM---------	A-4-------
	16-24	Sandstone.		

See footnote at end of table

PROPERTIES OF SOILS

Percentage passing sieve--			Available water capacity	Reaction	Shrink-swell potential	Permeability	Hydrologic soil group
No. 4	No. 10	No. 200					
			Inches per inch of soil	pH			
100	100	20-35	0.12	6.6-7.3	Low.	Moderate.	B.
100	100	36-50	.14	6.6-7.3	Low.		
100	100	20-35	.12	6.6-7.3	Low.		
90-100	90-100	5-10	.05	6.6-7.3	Low.		
100	100	75-90	.14	6.1-6.5	Low.	Slow.	C.
100	100	85-95	.17	6.6-7.3	Moderate to high.		
100	100	85-95	.17	7.4-8.4	Moderate to high.		
------	------	-----	----	-------	----------------	------------------	C.
------	------	-----	----	-------	----------------	------------------	B.
100	100	30-60	.12	5.6-7.3	Low.	Moderately rapid.	B.
100	100	36-50	.12	6.1-6.5	Low.	Slow.	C.
100	100	40-60	.14	6.1-6.5	Low to moderate.		
100	100	36-50	.12	6.6-7.3	Low.		
------	------	-----	----	-------	High.	Very slow.	D.
100	100	75-90	.14	5.6-6.0	Low.	Moderate.	B.
100	100	75-90	.14	7.9-8.4	Low.		
100	100	36-50	.14	6.1-6.5	Low.	Moderate.	B.
------	------	-----	----	-------	----------------	------------------	C.
100	100	30-50	.14	6.1-6.5	Low.	Moderately slow.	C.
100	100	55-85	.14	6.6-7.3	Low.		
100	100	85-95	.17	6.6-7.3	Moderate.		
100	100	75-90	.14	6.1-6.5	Low.	Moderate.	B.
100	100	85-95	.17	6.6-7.3	Low to moderate.		
100	100	75-90	.14	6.6-7.3	Low.		
100	100	75-90	.14	5.6-6.0	Low.	Moderately slow.	C.
100	100	85-95	.17	6.6-7.3	Moderate.		
100	100	36-50	.14	6.6-7.3	Low.	Moderate.	C.

TABLE 3.--ENGINEERING

Soil types, land types, complexes, and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Konawa loamy fine sand (KoB, KoC).	0-6	Loamy fine sand----------	SM---------	A-2, A-4---
	6-12	Fine sand----------------	SM---------	A-2--------
	12-28	Silty clay loam----------	SM, SC-----	A-4--------
	28-40	Silt loam----------------	SM-SC------	A-2--------
	40-60	Loamy fine sand----------	SM---------	A-2, A-4---
Kirkland silt loam (KrA).	0-10	Silt loam----------------	ML, CL-----	A-4--------
	10-26	Clay---------------------	CL, CH-----	A-6, A-7---
	26-60	Silty clay loam----------	CL---------	A-7, A-6---
Lela clay, wet (Lc, Le). (About 25 percent of mapping unit Le consists of Slickspots.)	0-36	Clay---------------------	MH---------	A-7--------
Leshara-Slickspots complex (Lh). (Estimates are for Leshara part of this mapping unit; about 25 percent of mapping unit consists of Slickspots.)	0-32	Fine sandy loam or loam--	ML---------	A-4--------
	32-60	Loamy fine sand----------	SM---------	A-4--------
Lincoln loamy fine sand (Ln).	0-18	Loamy fine sand----------	SM---------	A-2--------
	18-60	Fine sand----------------	SM-SP------	A-3--------
Lucien-Rock outcrop complex (Lr). (For properties of Lucien soils, refer to Kingfisher-Lucien complex; properties of Rock outcrop are not estimated.)				
McLain silty clay loam (Mc).	0-12	Silty clay loam----------	CL---------	A-4, A-6---
	12-30	Silty clay loam----------	ML-CL------	A-6, A-7---
	30-60	Silty clay loam----------	CL---------	A-6, A-7---
Miles fine sandy loam (MlB, MlC).	0-12	Fine sandy loam----------	SM---------	A-2, A-4---
	12-20	Silty clay loam----------	SC, CL-----	A-4--------
	20-32	Clay loam----------------	CL---------	A-6--------
	32-60	Silty clay loam----------	SC, CL-----	A-4, A-6---
Minco loam (MnA, MnB, MnC).	0-50	Loam---------------------	ML, CL-----	A-4--------
	50-60	Fine sandy loam----------	SM, SC-----	A-4--------
Minco very fine sandy loam (MoD, MoE).	0-18	Very fine sandy loam-----	ML---------	A-4--------
	18-50	Fine sandy loam----------	SM---------	A-4--------
Nobscot fine sand (NcB, NcC, NcD).	0-60	Fine sand----------------	SM---------	A-2--------
Norge loam (NoA, NoB, NoC, NoD, NsA). (About 15 to 25 percent of mapping unit NsA consists of Slickspots.)	0-12	Loam---------------------	ML, CL-----	A-4--------
	12-60	Clay loam----------------	CL---------	A-6, A-7---
Port clay loam (Pc).	0-60	Clay loam----------------	CL---------	A-6--------
Port loam (Po).	0-26	Loam---------------------	ML, CL-----	A-4--------
	26-60	Silty clay loam----------	SC, CL-----	A-4--------

See footnote at end of table

PROPERTIES OF SOILS--Continued

Percentage passing sieve-- No. 4	No. 10	No. 200	Available water capacity	Reaction	Shrink-swell potential	Permeability	Hydrologic soil group
			Inches per inch of soil	pH			
100	100	20-40	0.07	6.1-6.5	Low.	Moderate.	B.
100	100	11-20	.05	6.1-6.5	Low.		
100	100	36-50	.14	5.6-6.0	Low.		
100	100	11-30	.07	5.6-6.0	Low.		
100	100	20-40	.07	5.6-6.0	Low.		
100	100	75-90	.14	6.1-6.5	Low to moderate.	Very slow.	D.
100	100	75-90	.17	7.4-7.8	Moderate to high.		
100	100	85-95	.17	7.4-7.8	Moderate to high.		
100	100	90-95	.17	7.4-7.8	High.	Very slow.	D.
100	100	51-70	.14	7.4-7.8	Low.	Moderate.	B.
100	100	36-50	.07	7.4-7.8	Low.		
100	100	11-30	.07	7.4-7.8	Low.	Rapid.	A.
100	100	5-10	.05	7.4-7.8	Low.		
100	100	85-95	.17	6.6-7.3	Moderate.	Moderately slow.	C.
100	100	85-95	.17	7.4-7.8	Moderate.		
100	100	85-95	.17	7.4-7.8	Moderate.		
100	100	25-50	.14	6.6-7.3	Low.	Moderate.	B.
100	90-100	36-55	.14	6.6-7.3	Low.		
100	100	75-95	.17	6.6-7.3	Moderate.		
100	90-100	36-55	.14	6.6-7.3	Low to moderate.		
100	100	55-85	.14	6.6-7.3	Low.	Moderate.	B.
100	100	36-50	.14	7.4-7.8	Low.		
100	100	60-80	.14	7.4-7.8	Low.	Moderately rapid.	B.
100	100	36-50	.12	7.4-7.8	Low.		
100	100	11-25	.07	5.6-6.5	Low.	Moderately rapid.	A.
100	100	55-85	.14	6.1-6.5	Low.	Moderately slow.	C.
100	100	75-95	.17	6.6-7.8	Moderate.		
100	100	75-95	.17	7.4-7.8	Moderate.	Moderately slow.	C.
100	100	55-85	.14	7.4-8.4	Low.	Moderately slow.	B.
100	100	40-60	.14	7.9-8.4	Low.		

TABLE 3.--ENGINEERING

Soil types, land types, complexes, and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Pratt loamy fine sand (PrB, PrC).	0-50	Loamy fine sand	SM	A-2
Quinlan-Woodward loams (QwF):				
Quinlan loam.	0-10	Loam	ML, CL	A-4
	10	Sandstone.		
Woodward loam.	0-18	Loam	ML, CL	A-4
	18	Sandstone.		
Reinach very fine sandy loam (Ra).	0-40	Very fine sandy loam	ML	A-4
	40-60	Fine sandy loam	SM, SC	A-4
Renfrow silty clay loam (RcA, RcB, RnC2). (For properties of Vernon soils in mapping unit RnC2, refer to Vernon clay loam.)	0-10	Silty clay loam	CL	A-6
	10-50	Clay	CL, CH	A-7
	50	Shale.		
Rough broken land (Ro).	(1/)			
Sandy broken land (Sb).	(1/)			
Shellabarger fine sandy loam (ShA, ShC, StD, StD2). (Estimates are for Shellabarger part of mapping units; for properties of Teller part of mapping units StD and StD2, refer to Teller fine sandy loam.)	0-12	Fine sandy loam	SM	A-2, A-4
	12-34	Silty clay loam	SC, CL	A-6
	34-60	Silt loam	SM	A-2, A-4
St. Paul silt loam (SpA, SpB).	0-12	Silt loam	ML, CL	A-4
	12-36	Silty clay loam	CL	A-6
	36-60	Clay loam	CL	A-6
Tabler silty clay loam (Ta).	0-8	Silty clay loam	CL	A-6
	8-34	Clay	CL, CH	A-7
	34-54	Silty clay loam	CL	A-6, A-7
Teller fine sandy loam (TfA, TfC).	0-10	Fine sandy loam	ML, SM	A-4
	10-16	Loam	ML, CL	A-4, A-6
	16-40	Clay loam	CL	A-6
	40-60	Fine sandy loam	SM	A-2, A-4
Tivoli fine sand (TrD).	0-50	Fine sand	SM, SP	A-3
Vanoss loam (VaA, VaB).	0-16	Loam	ML, SM	A-4
	16-60	Clay loam	CL	A-4, A-6

See footnote at end of table

PROPERTIES OF SOILS--Continued

Percentage passing sieve-- No. 4	No. 10	No. 200	Available water capacity	Reaction	Shrink-swell potential	Permeability	Hydrologic soil group
			Inches per inch of soil	pH			
100	100	20-35	0.07	6.6-7.3	Low.	Moderately rapid.	A.
100	100	55-85	.14	7.4-7.8	Low.	Moderately rapid.	B.
100	100	55-85	.14	7.4-7.8	Low.	Moderate.	B.
100	100	60-80	.14	7.9-8.4	Low.	Moderate.	B.
100	100	36-50	.12	7.9-8.4	Low.		
100	100	85-95	.17	6.6-7.3	Moderate.	Very slow.	D.
100	100	90-100	.17	6.6-7.3	High.		
---	---	------	-----	-------	----------------	-----------------	D.
---	---	------	-----	-------	----------------	-----------------	C.
100	100	25-50	.14	6.1-6.5	Low.	Moderate.	B.
100	100	40-60	.14	6.6-7.3	Low to moderate.		
100	100	25-50	.14	6.6-7.3	Low.		
100	100	75-90	.14	6.6-7.3	Low.	Moderately slow.	C.
100	100	85-95	.17	7.4-7.9	Moderate.		
100	100	75-95	.17	7.4-7.9	Moderate.		
100	100	85-95	.17	6.6-7.3	Moderate.	Very slow.	D.
100	100	90-100	.17	6.6-7.8	High.		
100	100	85-95	.17	7.4-7.8	Moderate to high.		
100	100	36-55	.14	5.6-6.0	Low.	Moderate.	B.
100	100	70-90	.14	5.6-6.0	Low.		
100	100	75-95	.17	6.1-6.5	Moderate.		
100	100	25-50	.14	6.1-6.5	Low.		
100	100	5-10	.05	6.6-7.4	Low.	Rapid.	A.
100	100	40-60	.14	6.1-6.5	Low.	Moderate.	B.
100	100	51-70	.17	6.6-7.3	Moderate.		

TABLE 3.--ENGINEERING

Soil types, land types, complexes, and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Vernon clay loam (VeB, VeC, Vr). (About 25 percent of mapping unit Vr consists of outcrops of shale, sandstone, and gypsum.)	0-8	Clay loam	CL	A-6
	8-17	Clay	CL	A-6, A-7
	17	Shale.		
Wann soils (Wa).	0-32	Fine sandy loam	SM	A-2, A-4
	32-50	Silt	SP-SM	A-3
Wet alluvial land (Wt).	(1/)			
Yahola loam (Ya).	0-15	Loam	ML, CL	A-4
	15-34	Sandy loam	SM, SC	A-2, A-4
	34-60	Silt	SP-SM	A-3

1/ Variable.

The shrinkage ratio expresses the relation between the volume change of a soil and the corresponding change in water content, above the shrinkage limit. The volume change used in computing shrinkage ratio is the change that takes place in a soil when it dries from a given moisture content to the shrinkage limit.

Field moisture equivalent (FME) is the minimum moisture content at which a smooth soil surface will absorb no more water in 30 seconds when the water is added in individual drops. It is the moisture content required to fill all the pores in sands and to approach saturation in cohesive soils in their natural state. Volume change from field moisture equivalent is the change in volume, expressed as a percentage of the dry volume, that takes place when the moisture content of the soil is reduced from the field moisture equivalent to the shrinkage limit.

Mechanical analysis involves sorting soil components by particle size. All soils can be divided as either coarse grained or fine grained, according to percentage of particles passing the No. 200 sieve. Sand and other granular materials are retained on the No. 200 sieve, but silt and clay materials pass through it. Clay is the fraction passing the No. 200 sieve that is smaller than 0.005 millimeter in diameter. Material 0.074 to 0.005 millimeter in diameter is called silt.

Liquid limit and plastic limit indicate the effect of water on the consistence of soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which the soil material is plastic. Some silty and sandy soils are nonplastic; that is, they do not become plastic at any moisture content.

Classification and Morphology of Soils

This section contains a discussion of the major factors of soil formation; a classification of soils according to the current system; and a technical description of each soil series in the county.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil formation have acted on the parent material.

Climate and vegetation are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. Parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. The time may be much or little, but some time is always required for the differentiation of soil horizons. Generally a long time is required for the development of distinct horizons. The five factors of soil formation are so

PROPERTIES OF SOILS--Continued

Percentage passing sieve-- No. 4	No. 10	No. 200	Available water capacity	Reaction	Shrink-swell potential	Permeability	Hydrologic soil group
			Inches per inch of soil	pH			
100	100	75-95	0.17	7.4-7.8	Moderate.	Very slow.	D.
100	100	90-100	.17	7.4-7.8	High.		
100	100	20-40	.14	7.4-7.8	Low.	Moderately rapid.	A.
100	90-100	5-10	.05	7.4-7.8	Low.		
100	100	55-85	.14	7.4-7.8	Low.	Moderately rapid.	B.
100	100	30-50	.14	7.4-7.8	Low.		
100	100	5-10					

closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one unless conditions are specified for the other four.

Parent material

Parent material is the weathered, unconsolidated rock material from which soil is formed. It determines largely the chemical and mineralogical composition of the soil. In Blaine County the parent materials consist of old and recent alluvium and weathered sandstone, shale, and gypsum.

The soils on gently rolling upland prairies in the northeastern part of the county formed in materials weathered from interbedded sandstone and shale. Examples of soils formed in these parent materials are the Kingfisher and Renfrow soils. Soils formed in old alluvium occur in two large areas, one near Okeene and the other near Greenfield. Examples of soils formed in this material are the Bethany, Norge, Kirkland, and Tabler.

In the central and western parts of the county are two large areas where soils formed in old alluvial deposits of Pleistocene age. These deposits have been reworked slightly by wind. They are sandy to loamy in texture in most places and support a thick stand of blackjack oak trees. Examples of soils formed in these Pleistocene materials are the Nobscot, Konawa, and Shellabarger.

Deposits of old alluvium on high terraces occur in the extreme southwestern part of the county. Soils on these deposits developed under tall grass and include the Vanoss and Minco soils.

Massive beds of gypsum crop out in a wide belt east of Watonga. In most of this belt Vernon soils formed, but Lucien soils formed in some places.

The valleys of the North Canadian and South Canadian Rivers are of recent alluvium or of Quaternary age. The soils formed in this alluvium include the Port, Canadian, Dale, Lincoln, Wann, and Leshara.

In the rolling, hilly areas southwest of Watonga, the materials were derived from sandstone and dolomite. In most places the smoother areas are remnants of old alluvium that overlies sandstone. The soils formed in this old alluvium include the St. Paul, Vanoss, and, in places, Grant. Soils that developed in material weathered from the massive, bedded sandstone include the Dill, Quinlan, Woodward, Lucien, and Grant soils.

Climate

In Blaine County the warm, temperate, subhumid continental climate has been a dominant factor in soil formation. The average temperature and the distribution of rainfall are shown in table 7 of the section "Climate." The soils are warm enough for biological activity most of the year. Freezing and thawing have little effect on weathering because the soils are frozen for only a short period and to a depth of only a few inches. Mainly because of the dry, subhumid climate, few of the soils are strongly weathered or leached. Most of the soils are moderately fertile and range from slightly acid to mildly alkaline.

Plant and animal life

Grasses, trees, shrubs, earthworms, and other forms of plants and animals live on and in the soil. They are active in the soil-forming processes. As they die, their bodies decay and add organic matter to the soil, which darkens the upper layer. This addition of organic matter improves the structure and physical condition of the soil. Vegetation provides shade, which reduces the loss of moisture through evaporation.

TABLE 4.--ENGINEERING

Soil series, soil types, complexes, land types, and map symbols	Suitability as source of--			Soil features affecting--
	Topsoil	Select grading material	Road fill	Highway location
Albion soils (AbE).	Fair to poor: steep slopes easily eroded.	Good--------------	Good if material is confined and slopes are stabilized.	Strong slopes; slopes of cuts easily eroded.
Bethany (BeA).	Good to fair to a depth of $1\frac{1}{2}$ feet: steep slopes easily eroded.	Poor: unstable when wet; elastic.	Very poor: high shrink-swell potential; unstable when wet.	Very slow internal drainage; high shrink-swell potential; unstable when wet.
Breaks-Alluvial land complex (Bk).	Poor: material limited.	Poor: material clayey; amount limited.	Poor: clayey material in inaccessible areas.	Steep, broken canyons and stream channels.
Broken alluvial land (Br).	Poor: areas inaccessible.	Poor: areas inaccessible.	Poor: areas inaccessible; material limited.	Steep, broken streambanks and channels.
Canadian (Ca).	Poor: easily eroded.	Good--------------	Good if material is confined and slopes are stabilized.	Features favorable---
Carwile-Shellabarger complex (CsA).	Poor: easily eroded.	Good to fair: suitable material limited in Carwile soil.	Good for Shellabarger soil; poor for Carwile soil.	Somewhat poorly drained depressions.
Clayey saline alluvial land (Cy).	Poor: material clayey and saline.	Unsuitable: clayey.	Very poor--------	Frequent flooding; high shrink-swell potential; very slow internal drainage; unstable when wet.
Dale (Da).	Good to fair: steep slopes easily eroded.	Poor: unstable when wet; elastic.	Poor: low density; difficult to compact; rapid capillary movement of water.	Unstable subgrade even after compaction.

INTERPRETATIONS OF SOILS

Soil features affecting--continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
High seepage; sand at a depth of 2 feet.	Stable material; some seepage; easily eroded.	Not needed--	Strong slopes; low water-holding capacity.	Strong slopes----	Strong slopes; easily gullied.
Features favorable.	Susceptibility to cracking when dry; low shear strength.	Not needed--	Slow intake rate; soil cracks when dry.	Slow internal drainage.	Soil cracks when dry; droughty.
Areas good for natural storage.	Features favorable.	Steep broken land; nonarable.	Steep broken land; nonarable.	Steep broken land; nonarable.	Steep broken land; shallow soil.
Broken land; narrow alluvial streambanks; no suitable sites.	Limited borrow material.	Broken land; nonarable.	Broken land; nonarable; susceptibility to flooding.	Broken land; nonarable.	Steep broken land; susceptibility to flooding.
High seepage-----	High seepage; easily eroded.	Not needed--	Features favorable--	Not needed; nearly level slopes.	Nearly level slopes.
High seepage-----	Features favorable.	Somewhat poorly drained depressions without available outlets.	Somewhat poorly drained depressions; slight hazard of wind	Undulating topography.	Undulating topography.
Features favorable.	Susceptibility to cracking when dry; low shear strength.	Frequent flooding; very slow internal drainage; saline.	Saline soils; poor drainage; frequent flooding.	Nearly level slopes; soils crack when dry.	Low fertility; droughty; saline.
Features favorable.	Unstable material; difficult to compact.	Not needed--	Features favorable--	Nearly level slopes.	Nearly level slopes.

TABLE 4.--ENGINEERING

Soil series, soil types, complexes, land types, and map symbols	Suitability as source of--			Soil features affecting--
	Topsoil	Select grading material	Road fill	Highway location
Dill (DfA, DfB, DfD, DfD2).	Poor: easily eroded.	Good--------------	Good if material is confined and slopes are stabilized.	Slopes or cuts easily eroded.
Eroded loamy land (Er).	Poor: material limited.	Poor: material unstable when wet; amount limited.	Good to fair------	Steep slopes; many gullies.
Farnum (FaA).	Poor to fair: easily eroded.	Good: material limited.	Fair to poor: close moisture control required; unstable when wet.	Subgrade material unstable when wet.
Grant silt loam (GrB, GrC, GrD, GrD2).	Good to fair: steep slopes easily eroded.	Poor: unstable when wet; elastic.	Poor: close moisture control required; unstable when wet.	Material unstable when wet; good subgrade drainage required.
Kingfisher silt loam (KfA, KfB).	Good to fair: steep slopes easily eroded.	Poor: unstable when wet; elastic.	Poor: close moisture control required; unstable when wet.	Material unstable when wet; good subgrade drainage required.
Kingfisher-Grant silt loams (KgC).	Good to fair: steep slopes easily eroded.	Poor: unstable when wet; elastic.	Poor: close moisture control required; unstable when wet.	Material unstable when wet; good subgrade drainage required.
Kingfisher-Lucien complex (KhD2).	Fair to poor: steep slopes easily eroded.	Poor: unstable---	Poor: material is heavy clay or sandstone.	Features favorable---
Kingfisher-Slickspots complex (KlB).	Good to fair: steep slopes easily eroded.	Poor: unstable when wet; elastic.	Poor: close moisture control required; unstable when wet.	Material unstable when wet; good subgrade drainage required.
Kirkland (KrA).	Poor: material limited; easily eroded.	Poor: unstable when wet.	Very poor: high shrink-swell potential; unstable when wet.	Very slow internal drainage; high shrink-swell potential; unstable.

INTERPRETATIONS OF SOILS--Continued

Soil features affecting--continued						
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
High seepage; soft sandstone at depth of 3½ feet.	Slight risk of leakage; easily eroded.	Not needed--	Limited root zone; slight hazard of wind erosion.	Slight susceptibility to wind erosion.	Slight susceptibility to deposition by wind.
Steep slopes; moderate seepage.	Easily eroded soils.	Not needed--	Steep, severely eroded slopes.	Steep slopes; severe erosion.	Steep slopes; severe erosion.
Features favorable.	Features favorable.	Not needed--	Features favorable--	Features favorable.	Features favorable.
Features favorable.	Features favorable.	Not needed--	Features favorable on more nearly level slopes.	Features favorable.	Features favorable.
Features favorable.	Features favorable.	Not needed--	Features favorable--	Features favorable.	Features favorable.
Features favorable.	Features favorable.	Not needed--	Features favorable--	Features favorable.	Features favorable.
Features favorable except in places where sandstone is encountered.	Features favorable.	Not needed--	Eroded soils; some shallow over rock; Slickspots in places.	Unstable Slickspots.	Unstable Slickspots.
Features favorable.	Features generally favorable; Slickspots unstable.	Not needed--	Saline-alkali depressions.	Unstable Slickspots.	Unstable Slickspots.
Features favorable.	Susceptibility to cracking when dry; high fills unstable.	Not needed--	Very slow intake rate and permeability.	Very slow internal drainage.	Soil cracks when dry; droughty.

TABLE 4.--ENGINEERING

Soil series, soil types, complexes, land types, and map symbols	Suitability as source of-- Topsoil	Select grading material	Road fill	Soil features affecting-- Highway location
Konawa (KoB, KoC).	Poor: material too sandy.	Good-------------	Good if slopes are stabilized.	Slopes of cuts easily eroded.
Lela (Lc, Le). (About 25 percent of mapping unit Le consists of Slickspots.)	Poor: material too clayey.	Unsuitable: high content of clay.	Very poor: high shrink-swell potential; unstable when wet.	Very slow internal drainage; very high shrink-swell potential; high water table.
Leshara-Slickspots complex (Lh).	Poor: easily eroded.	Good except for Slickspots.	Good to fair: Slickspots unstable.	High water table; occasional flooding.
Lincoln (Ln).	Poor: easily eroded.	Good--------------	Good if slopes are stabilized.	Occasional flooding--
Lucien-Rock outcrop complex (Lr).	Poor: easily eroded.	Good--------------	Fair to good: soft sandstone below depth of 1½ feet.	Moderately steep slopes; soft sandstone below depth of 1½ feet.
McLain (Mc).	Good---------------	Unsuitable: material too clayey.	Poor: close moisture control required; unstable when wet.	Very slow internal drainage; unstable when wet; good subgrade drainage required.
Miles (MlB, MlC).	Fair: material too sandy; easily eroded.	Good--------------	Fair to good: unstable when wet.	Features favorable---
Minco (MnA, MnB, MnC, MoD, MoE).	Good to fair: steep slopes easily eroded.	Fair to good------	Good to fair: close moisture control required.	Slopes of cuts easily eroded.
Nobscot (NcB, NcC, NcD).	Poor: steep slopes easily eroded.	Fair: binder needed.	Good if slopes are stabilized and material is confined.	Slopes of cuts easily eroded.
Norge loam (NoA, NoB, NoC, NoD).	Good---------------	Unsuitable--------	Fair to poor: unstable when wet.	Material unstable when wet; good subgrade drainage required.

INTERPRETATIONS OF SOILS--Continued

Soil features affecting--continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
Excessive seepage.	High seepage; easily eroded.	Good natural drainage.	Wind erosion; high intake rate.	Susceptibility to wind erosion.	Susceptibility to deposition by wind and to gully erosion.
Features favorable.	Susceptibility to cracking when dry; unstable.	High water table; very slow permeability.	Very slow intake rate and permeability; high water table.	Nearly level slopes; very slow permeability.	Nearly level slopes.
Features favorable.	High water table; easily eroded.	High water table.	High water table---	Nearly level slopes.	Nearly level slopes; high water table.
High seepage-----	High seepage----	Occasional flooding.	High intake rate; occasional flooding.	Nearly level slopes; occasional flooding.	Nearly level slopes; occasional flooding.
Moderately steep slopes; sandstone below depth of 1½ feet.	Moderately steep slopes; easily eroded.	Moderately steep slopes; nonarable.	Moderately steep slopes; nonarable.	Moderately steep slopes; nonarable.	Moderately steep slopes; shallowness to sandstone.
Features favorable.	Features favorable.	Good natural drainage.	Features favorable-	Nearly level soil.	Nearly level soil.
Susceptibility to seepage below depth of 4 feet.	Material fairly easily eroded.	Not needed-	Susceptibility to wind erosion.	Susceptibility to wind erosion.	Susceptibility to wind erosion.
Susceptibility to seepage below depth of 4 feet.	Material fairly easily eroded.	Not needed-	Features favorable except on steeper slopes.	Features favorable.	Susceptibility to gully erosion.
High seepage----	High seepage; easily eroded.	Not needed-	Susceptibility to wind erosion; rapid intake rate; low water-holding capacity.	Susceptibility to wind erosion; unstable on ridges; terraces not needed.	Susceptibility to wind deposition and to gully erosion.
Seepage below depth of 5 feet.	Features favorable.	Not needed-	Features favorable except on steeper slopes.	Features favorable.	Features favorable.

TABLE 4.--ENGINEERING

Soil series, soil types, complexes, land types, and map symbols	Suitability as source of--			Soil features affecting--
	Topsoil	Select grading material	Road fill	Highway location
Norge-Slickspots complex (NsA).	Good except for Slickspots.	Unsuitable-------	Fair to poor: unstable when wet.	Material unstable when wet; good subgrade drainage required.
Port clay loam (Pc).	Good--------------	Unsuitable: material too clayey.	Poor: unstable when wet.	Occasional flooding; unstable when wet; nearly level.
Port loam (Po).	Good--------------	Unsuitable-------	Fair: unstable when wet.	Material unstable when wet; nearly level.
Pratt (PrB, PrC).	Poor: material too sandy; easily eroded.	Good-------------	Good if slopes are stabilized.	Slopes of cuts easily eroded.
Quinlan-Woodward loams (QwF):				
Quinlan loam.	Poor: material easily eroded; amount limited.	Poor: shallow over rock.	Good to fair: slopes easily eroded.	Some slopes more than 12 percent.
Woodward loam.	Poor: shallow over sandstone.	Poor: material elastic; amount limited.	Fair to good: soft sandstone at depth of 2 feet.	Moderately steep slopes; soft sandstone at depth of 2 feet.
Reinach (Ra).	Fair: easily eroded.	Good-------------	Good-------------	Features favorable----
Renfrow silty clay loam (RcA, RcB).	Fair to poor: shallow over clay.	Unsuitable: material too clayey.	Poor: high plasticity; unstable when wet; high shrink-swell potential.	Unstable material; high shrink-swell potential.
Renfrow-Vernon complex (RnC2).	Poor: material limited.	Unsuitable: material too clayey.	Poor: high plasticity; unstable when wet; high shrink-swell potential.	Unstable material; high shrink-swell potential.
Rough broken land (Ro).	Poor: steep slopes.	Unsuitable; material too clayey; steep slopes.	Poor: clayey material and gypsum rock.	Clayey material and gypsum rock; steep slopes.
Sandy broken land (Sb).	Poor: material limited; too sandy.	Poor: material limited.	Poor: sandy soil material over heavy clay.	Moderately steep slopes.

INTERPRETATIONS OF SOILS--Continued

Soil features affecting--continued						
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
Seepage below depth of 5 feet.	Features favorable; Slickspots unstable.	Not needed--	Slickspots have high sodium content.	Unstable Slickspots.	Unstable Slickspots; droughty.
Features favorable.	Features favorable.	Good natural drainage; occasional flooding.	Occasional flooding.	Nearly level slopes; occasional flooding.	Nearly level slopes; occasional flooding.
Features favorable.	Features favorable.	Not needed-	Features favorable-	Nearly level slopes.	Nearly level slopes.
High seepage-----	High seepage; easily eroded.	Not needed-	Susceptibility to wind erosion; high intake rate; low water-holding capacity.	Not needed-------	Susceptibility to wind deposition; droughty.
High seepage; steep slopes.	High seepage; susceptibility to piping.	Not needed-	Shallowness to sandstone.	Shallowness to sandstone; steep slopes.	Moderately steep slopes; shallowness.
Moderately steep slopes; sandstone at depth of 2 feet.	Moderately steep slopes; susceptibility to piping.	Not needed-	Moderately steep slopes; shallowness.	Moderately steep slopes; shallowness.	Moderately steep slopes; shallowness.
High seepage-----	High seepage; easily eroded.	Not needed-	Features favorable-	Nearly level slopes.	Nearly level slopes.
Features favorable.	Material cracks when dry; low shear strength.	Very slow internal drainage.	Very slow intake rate; soils crack when dry; susceptible to salt accumulation.	Very slow internal drainage.	Features favorable.
Shale or siltstone at depth of 2 feet.	Material cracks when dry; low shear strength.	Not needed-	Shallow clayey soils.	Very slow internal drainage.	Droughtiness.
Very steep slopes; cavernous gypsum bedrock.	Very steep slopes; unstable; gypsum rock.	Not needed-	Very steep slopes; rock outcrops.	Very steep slopes; rock outcrop.	Very steep slopes; rock outcrops.
Moderately steep slopes.	Moderately steep slopes; sand.	Moderately steep slopes; nonarable.	Moderately steep slopes; nonarable.	Moderately steep slopes.	Moderately steep slopes; droughty.

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TABLE 4.--ENGINEERING

Soil series, soil types, complexes, land types, and map symbols	Suitability as source of--			Soil features affecting--
	Topsoil	Select grading material	Road fill	Highway location
St. Paul (SpA, SpB).	Good----------------	Unsuitable; material too clayey.	Poor: close moisture control required; unstable when wet.	Material unstable when wet; good subgrade drainage required.
Shellabarger fine sandy loam (ShA, ShC).	Fair: steep slopes easily eroded.	Good--------------	Good--------------	Features favorable---
Shellabarger-Teller fine sandy loams (StD, StD2).	Fair to poor: easily eroded.	Good to fair------	Good--------------	Features favorable---
Tabler (Ta).	Poor: too clayey--	Unsuitable: material too clayey.	Poor: unstable when wet; high shrink-swell potential.	Material unstable when wet; high shrink-swell potential; perched water table.
Teller fine sandy loam (TfA, TfC).	Poor: easily eroded.	Good to fair------	Good--------------	Features favorable---
Tivoli (TrD).	Poor: easily eroded.	Fair: binder needed.	Fair if material is confined and slopes are stabilized.	Slopes of cuts easily eroded.
Vanoss (VaA, VaB).	Good to fair: steep slopes easily eroded.	Fair: elastic----	Poor: unstable when wet.	Material unstable when wet.
Vernon clay loam (VeB, VeC).	Poor: too clayey--	Unsuitable: material too clayey.	Poor: shallow, clayey material over shale or siltstone.	Unstable clayey material over shale or siltstone.
Vernon soils and Rock outcrop (Vr).	Poor---------------	Unsuitable: material too clayey.	Poor: clayey material and Rock outcrop.	Clayey material; Rock outcrop; steep slopes.
Wann (Wa).	Poor: easily eroded.	Good: water table at depth of 3 feet.	Good: water table at depth of 3 feet.	Water table at depth of 3 feet.
Wet alluvial land (Wt).	Poor: mixed material; high water table.	Poor: mixed material; high water table.	Poor: high water table.	High water table; frequent flooding.

INTERPRETATIONS OF SOILS--Continued.

Soil features affecting--continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
Features favorable.	Features favorable.	Not needed--	Features favorable--	Features favorable.	Features favorable.
High seepage in places.	Features favorable.	Not needed--	Slight hazard of wind erosion.	Features favorable.	Features favorable.
Occasional high seepage in places.	Features favorable.	Not needed--	Slight hazard of wind erosion.	Features favorable.	Features favorable.
Features favorable.	Low shear strength; cracks when dry.	Perched water table; slow permeability.	Very slow intake rate and permeability.	Nearly level slopes; very slow permeability.	Nearly level slopes.
High seepage in places.	Features favorable.	Not needed--	Slight hazard of wind erosion.	Features favorable.	Features favorable.
High seepage-----	High seepage; easily eroded.	Not needed--	Dune sand-----------	Dune sand; terraces and diversions not needed.	Not needed.
Features favorable.	Features favorable.	Not needed--	Features favorable--	Features favorable.	Features favorable.
Features favorable.	Slopes easily eroded; vegetation difficult to establish.	Not needed--	Very slow intake rate; shallow to shale or siltstone.	Shallowness to shale in some places.	Droughtiness.
Steep slopes; Rock outcrop.	Steep slopes; Rock outcrop; clayey material.	Not needed; nonarable.	Steep slopes; Rock outcrop; nonarable.	Steep slopes; Rock outcrop; nonarable.	Steep slopes; Rock outcrop; nonarable.
Water table at depth of 3 feet.	High seepage; easily eroded.	Water table at depth of 3 feet.	Water table at depth of 3 feet.	Nearly level slopes.	Nearly level slopes.
High water table-	Mixed soil material.	High water table; poor surface drainage; frequent flooding.	High water table; frequent flooding.	Frequent flooding.	Frequent flooding.

TABLE 4.--ENGINEERING

Soil series, soil types, complexes, land types, and map symbols	Suitability as source of--			Soil features affecting--
	Topsoil	Select grading material	Road fill	Highway location
Yahola (Ya).	Fair: easily eroded.	Fair to good: surface layer somewhat elastic.	Good---------------	Susceptibility to flooding.

Many kinds of micro-organisms are needed in the soils to change the remains of plants and animals into humus from which plants can obtain nutrients. These micro-organisms help to decompose plant residue and to hasten soil formation. They also affect the chemical reactions in the soil, and they convert plant nutrients into forms that are more readily available to higher plants.

Earthworms and small burrowing animals influence soil formation by mixing the soil materials. They help to keep plants supplied with minerals by bringing up soil material from the lower part of the solum and mixing it with the surface layer. The kind, number, and variety of plants and animals in and on the soil are determined largely by the climate.

Relief

Relief, or lay of the land, influences soil formation because of its effect on moisture, temperature, and erosion. This influence, however, is modified by the influence of the other soil-forming factors.

In Blaine County most slopes range from 0 to 8 percent, but some are as much as 20 percent or more. Most upland soils in the county have moderate slopes and thick, well-developed profiles. On some steeper soils, geologic erosion removes soil material almost as fast as it forms. As a result, these soils have thin, weakly expressed profiles.

On the bottoms and stream terraces, the soils are mostly nearly level or gently sloping. Here, the soils are young because the parent material has been in place for a relatively short time.

Time

The length of time needed for soil to form depends to a large extent on the other factors of soil formation. Soils develop more rapidly in humid, warm regions that have luxuriant vegetation than in dry or cold regions with scanty vegetation.

The age of soils in Blaine County varies widely. Soils on the smoother uplands and old high terraces have been in place a long time and have more mature development. On the steeper slopes, soil development has been retarded by the effects of runoff and erosion. Consequently, the horizons are not so thick nor so strongly developed as those of the more mature soils. On first bottoms where local alluvium is deposited, the materials have not been in place long enough for mature soils to develop.

Classification of Soils

Soils are placed in narrow classes for the organization and application of knowledge about their behavior within farms, ranches, or counties. They are placed in broad classes for study and comparisons of large areas such as continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*6*) and revised later (*5*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study (*2*, *4*). Therefore, readers interested in developments of the system should search the latest literature available. In table 6 some of the classes in the current system and the great soil group in the older system are given for each soil series in the county. The classes in the current system are briefly defined in the following paragraphs.

ORDER: Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of the soils. Two exceptions are the Entisols and Histosols, which occur in many different climates. Because of the importance of climate to soil formation, the orders to some extent are climatic zonal groups, and tend to have definite geographic ranges. Table 6 shows that the soil orders, Mollisols, Inceptisols, Alfisols, Entisols, and Vertisols, have been recognized in Blaine County.

SUBORDERS: Each order is divided into suborders. Soils within a suborder are similar in properties that mainly reflect the presence or absence of waterlogging or soil differences resulting from climate or vegetation. Those properties are mineralogy, chemistry, degree of gleying, soil moisture, texture, and the presence or absence of

INTERPRETATIONS OF SOILS--Continued

Soil features affecting--continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
High seepage-----	High seepage; easily eroded.	Susceptibility to flooding.	Susceptibility to flooding.	Nearly level slopes.	Nearly level slopes; susceptibility to flooding.

accumulated soluble material. The suborder is not shown in table 6.

GREAT GROUP: Suborders are separated into great groups on the basis of uniformity in the presence, absence, and arrangement of diagnostic horizons and features. The diagnostic horizons are those that contain illuvial clay, iron, humus; or they are thick, dark-colored surface horizons; or horizons having a pan that interferes with water movement or root development. The features are colors of dark brown and dark red that are associated with basic rocks, major differences in chemical composition, and wide differences in base saturation. The great group is not shown in table 6 for the current system of classification. The name of the great group is the last word in the name of the subgroup.

SUBGROUP: The subgroups are subdivisions of the great group and are defined in terms of reference to the great groups. One of the subgroups represents the central (typic) concept of the great group, and others, called intergrades, have properties of one great group that are dominant and also weakly expressed properties of another great group, suborder, or order. Subgroups may also be made where there is some soil property unlike that of the great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Udic Paleustolls.

FAMILY: Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, consistence, permeability, reaction, mineralogy, soil temperature, and thickness of horizons. An example is fine silty mixed, thermic family of Udic Paleustolls.

Soil series

Described in this subsection are the soil series recognized in Blaine County. Given for each soil series is a profile that was observed at a specified location. This profile is considered representative of the series. Because Port loam and Port clay loam have significantly different characteristics, a profile of each of these soils was described. Two profiles are also described for the Minco series. The individual soils in each series are shown on the map sheets at the back of this soil survey and are described in the section "Descriptions of the Soils."

ALBION SERIES

The Albion series consists of soils that developed on uplands in thick, sandy and gravelly material that was derived from Pleistocene deposits. These soils have a fine sandy loam to very gravelly loamy sand A1 horizon and a red loamy B2t horizon.

The Albion soils contain more sand and gravel than the Shellabarger and are underlain by coarser materials that are nearer the surface.

Profile of Albion sandy loam, 5 to 12 percent slopes, in a native range (south side of road, 1,300 feet east of the northwest corner of sec. 14, T. 13 N., R. 12 W.):

A1—0 to 10 inches, dark-brown (7.5YR 4/2) sandy loam, dark brown (7.5YR 3/2) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; neutral; gradual boundary; horizon 4 to 12 inches thick.

B2t—10 to 18 inches, red (2.5YR 4/6) light sandy clay loam, dark red (2.5YR 3/6) when moist; massive; hard when dry, friable when moist; some coarse sand and gravel; neutral; gradual boundary; horizon 5 to 10 inches thick.

B3—18 to 26 inches, red (2.5YR 4/6) coarse sandy loam, dark red (2.5YR 3/6) when moist; massive; hard when dry; friable when moist; pockets of gravel; neutral; gradual boundary; horizon 6 to 12 inches thick.

C—26 to 40 inches +, yellowish-red (5YR 5/6) coarse sand, yellowish red (5YR 4/6) when moist; single grain; loose; gravelly; neutral.

The A1 horizon ranges from dark brown to brown in color. It ranges from loamy sand to sandy loam or loam in texture, but it is dominantly sandy loam. The B2t horizon ranges from heavy sandy loam to sandy clay loam. Depth to coarse sand and gravel ranges from about 20 to 40 inches. The content of coarse sand and gravel in the C horizon, by volume, ranges from 50 to 70 percent.

BETHANY SERIES

In the Bethany series are nearly level soils of the uplands. These soils developed in silty material that was derived from Pleistocene deposits.

In the Bethany soils the A1 horizon is thicker than that in the Kirkland soils, and there is a transitional B1 horizon that the Kirkland soils lack. Bethany soils are darker than the St. Paul soils and have a thinner B1 horizon.

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TABLE 5.--ENGINEERING

[Tests performed by the Oklahoma Department of Highways in accordance with standard

Soil name and location	Parent material	Oklahoma report No.	Depth	Horizon	Shrinkage		Volume change from field moisture equivalent 1/
					Limit	Ratio	
			Inches				Percent
Dill fine sandy loam: 300 feet west and 100 feet north of southeast corner, sec. 6, T. 18 N., R. 13 W. Modal profile.	Red sandstone.	SO-7522	0-6	Ap------	5/ NP	5/ NP	5/ NP
		SO-7523	16-26	B2------	19	1.73	7
		SO-7524	34-42	C1------	19	1.72	5
Lela clay, wet: 1,320 feet west of northeast corner, sec. 3, T. 18 N., R. 13 W. Modal profile.	Alluvium.	SO-7528	0-24	A1------	11	1.97	110
		SO-7529	24-36	AC------	11	1.97	113
McLain silty clay loam: Center of SW¼, sec. 7, T. 15 N., R. 11 W. Modal profile.	Alluvium of high terraces.	SO-7541	0-6	Ap------	15	1.87	19
		SO-7542	12-32	AC------	11	2.01	52
		SO-7543	32-42	C-------	11	2.04	59
Minco loam: 1,320 feet south and 600 feet east of northwest corner, sec. 10, T. 14 N., R. 13 W. Modal profile.	Alluvium of high terraces.	SO-7539	0-6	Ap------	20	1.72	6
		SO-7540	44-70	Cca-----	16	1.87	7
Nobscot fine sand: 0.75 mile south of northeast corner, sec. 8, T. 18 N., R. 12 W. Nonmodal profile (thin surface).	Alluvium of high terraces (Pleistocene).	SO-7530	4-11	A2------	NP	NP	NP
		SO-7531	11-30	B2------	NP	NP	NP
		SO-7532	30-48	C-------	NP	NP	NP
Renfrow silty clay loam: 300 feet south and 100 feet east of southwest corner, sec. 17, T. 19 N., R. 10 W. Modal profile.	Permian redbeds.	SO-7533	0-8	Ap------	13	1.93	36
		SO-7534	8-26	B2------	11	2.03	61
		SO-7535	32-42	C-------	9	2.08	65
Vanoss loam: 500 feet north and 100 feet west of southeast corner, sec. 11, T. 15 N., R. 13 W. Modal profile.	Alluvium of high terraces.	SO-7536	0-6	Ap------	NP	NP	NP
		SO-7537	14-26	B2------	15	1.86	24
		SO-7538	26-42	B3------	13	1.90	40

1/ Based on AASHO Designation: T 99-57, Method A (1).

2/ Mechanical analyses according to the AASHO Designation T 88-57 (1). Results by this procedure may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

3/ Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 8): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes. AASHO Designation: M 145-49. Oklahoma Department of Highways classification procedure further subdivides the AASHO subgroup A-2-4 into the following: A-2-3 if the plasticity index shows material is nonplastic; A-2 if

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procedures of the American Association of State Highway Officials (AASHO) (1)]

Mechanical analysis 2/						Liquid limit	Plasticity index	Classification	
Percentage passing sieve--			Percentage smaller than--					AASHO 3/	Unified 4/
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.				
100	99	45	25	10	9	6/ NL	5/ NP	A-4(2)------	SM.
100	99	41	24	18	17	25	5	A-4(1)------	SM-SC.
100	99	39	20	16	15	22	3	A-4(1)------	SM.
---	100	99	93	78	65	82	40	A-7-5(20)---	MH.
---	100	99	91	77	65	94	48	A-7-5(20)---	MH.
---	100	85	68	31	29	28	10	A-4(8)------	CL.
---	100	91	81	54	49	46	21	A-7-6(14)---	ML-CL.
---	100	92	82	62	56	47	24	A-7-6(15)---	CL.
100	99	84	69	15	12	24	3	A-4(8)------	ML.
100	96	48	37	17	15	20	4	A-4(3)------	SM-SC.
100	95	21	8	5	5	NL	NP	A-2-3(0)----	SM.
100	83	19	12	10	10	NL	NP	A-2-3(0)----	SM.
100	90	15	10	8	8	NL	NP	A-2-3(0)----	SM.
100	97	93	83	39	35	37	15	A-6(10)-----	CL.
100	98	94	86	47	43	47	23	A-7-6(15)---	CL.
7/ 99	96	92	85	48	43	50	27	A-7-6(17)---	CL.
100	98	46	28	10	9	NL	NP	A-4(2)------	SM.
100	98	54	41	25	23	29	10	A-4(4)------	CL.
100	98	57	44	32	31	39	17	A-6(7)------	CL.

the plasticity index ranges from nonplastic to 5; and A-2-4 if plasticity index ranges from 5 to 10. The group index number for each of these subgroups is 0.

4/ Based on the Unified Soil Classification System, Waterways Experiment Station, Corps of Engineers, March 1953 (7). Soil Conservation Service and Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within 2 points of the A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are SM-SC and ML-CL.

5/ NP used in this column means nonplastic.

6/ NL used in this column means nonliquid.

7/ A No. 4 sieve passes 100 percent.

TABLE 6.--SOIL SERIES CLASSIFIED ACCORDING TO THE CURRENT SYSTEM AND THE REVISED 1938 SYSTEM OF CLASSIFICATION

Series	Current classification			1938 classification
	Family	Subgroup	Order	
Albion	Fine loamy over sandy skeletal, mixed, thermic.	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Bethany	Fine, mixed, thermic	Udic Paleustolls	Mollisols	Reddish Prairie soils.
Canadian	Coarse loamy, siliceous, thermic.	Udic Haplustolls	Mollisols	Alluvial soils.
Carwile	Fine mixed, noncalcareous, thermic.	Typic Argiaquolls	Mollisols	Planosols.
Dale	Fine silty, mixed, thermic	Udic Haplustolls	Mollisols	Alluvial soils.
Dill	Coarse loamy, mixed, thermic.	Typic Ustochrepts	Inceptisols	Reddish Chestnut soils.
Farnum	Fine, mixed, mesic	Udic Argiustolls	Mollisols	Brunizems.
Grant	Fine silty, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Kingfisher	Fine silty, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Konawa	Fine loamy, mixed, thermic	Ultic Haplustalfs	Alfisols	Red-Yellow Podzolic soils.
Kirkland	Fine, mixed, thermic	Abruptic Paleustolls	Mollisols	Reddish Prairie soils.
Lela	Fine, mixed, thermic	Typic Chromuderts	Vertisols	Alluvial soils.
Leshara	Fine silty, mixed, mesic	Aquic Haplustolls	Mollisols	Alluvial soils.
Lincoln 1/	Mixed, nonacid, thermic	Typic Ustipsamments	Entisols	Alluvial soils.
Lucien	Loamy, mixed, thermic, thin	Typic Haplustolls	Mollisols	Lithosols.
McLain	Fine, mixed, thermic	Udic Argiustolls	Mollisols	Alluvial soils.
Miles	Fine loamy, mixed, thermic	Typic Haplustalfs	Alfisols	Reddish Chestnut soils.
Minco	Coarse silty, mixed, thermic.	Udic Haplustolls	Mollisols	Reddish Chestnut soils.
Nobscot	Loamy, mixed, thermic	Arenic Haplustalfs	Alfisols	Red-Yellow Podzolic soils.
Norge	Fine silty, mixed, thermic	Udic Paleustolls	Mollisols	Reddish Prairie soils.
Port	Fine silty, mixed, thermic	Fluventic Haplustolls	Mollisols	Alluvial soils.
Pratt	Sandy, mixed, thermic	Udic Haplustalfs	Alfisols	Chestnut soils.
Quinlan	Loamy, mixed, thermic, thin	Typic Ustochrepts	Inceptisols	Regosols.
Reinach	Coarse silty, mixed, thermic.	Udic Haplustolls	Mollisols	Alluvial soils.

See footnote at end of table.

TABLE 6.--SOIL SERIES CLASSIFIED ACCORDING TO THE CURRENT SYSTEM AND THE REVISED 1938 SYSTEM OF CLASSIFICATION--Continued

Series	Current classification			1938 classification
	Family	Subgroup	Order	
Renfrow	Fine, mixed, thermic	Vertic Paleustolls	Mollisols	Reddish Prairie soils.
Shellabarger	Fine loamy, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
St. Paul	Fine silty, mixed, thermic	Typic Paleustolls	Mollisols	Reddish Chestnut soils.
Tabler	Fine, mixed, thermic	Abruptic Paleustolls	Mollisols	Chernozems intergrading to Planosols.
Teller	Fine loamy, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Tivoli	Mixed, nonacid, thermic	Typic Ustipsamments	Entisols	Regosols.
Vanoss	Fine silty, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Vernon	Clayey, mixed, thermic, thin.	Typic Ustochrepts	Inceptisols	Lithosols.
Wann	Coarse loamy, mixed, mesic	Aquic Haplustolls	Mollisols	Alluvial soils.
Woodward	Coarse silty, mixed, thermic.	Typic Ustochrepts	Inceptisols	Chestnut soils intergrading to Regosols.
Yahola	Coarse loamy, mixed, calcareous, thermic.	Typic Ustifluvents	Entisols	Alluvial soils.

1/ In later surveys the soils in this series have been placed in the Crevasse series.

Profile of Bethany silt loam, 0 to 1 percent slopes, in a cultivated field (west side of road, about 500 feet north of the center of sec. 23, T. 14 N., R. 11 W.):

A1—0 to 14 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; slightly acid; gradual boundary; horizon 10 to 18 inches thick.

B1—14 to 20 inches, dark grayish-brown (10YR 4/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, subangular blocky structure; hard when dry, firm when moist; neutral; clear boundary; horizon 3 to 6 inches thick.

B21t—20 to 32 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam, dark brown (10YR 3/3) when moist; moderate, medium, blocky structure; very hard when dry, very firm when moist; slowly permeable; mildly alkaline; gradual boundary; horizon 10 to 15 inches thick.

B22t—32 to 54 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam, dark brown (10YR 3/3) when moist; weak, fine, subangular blocky structure; very hard when dry, firm when moist; moderately alkaline; many fine segregated concretions of calcium carbonate.

B3—54 to 60 inches +, strong-brown (7.5YR 5/5) heavy silty clay loam, strong brown (7.5YR 4/5) when moist; weak, fine, subangular blocky structure; very hard when dry, firm when moist; moderately alkaline; many fine segregations of calcium carbonate.

The A1 horizon ranges from very dark grayish brown to dark brown and is loam in some places. The B2t horizon ranges from heavy silty clay loam to light clay in texture and from dark grayish brown to dark brown in color. Depth to the B21t horizon ranges from 15 to 22 inches.

CANADIAN SERIES

The Canadian series consists of well-drained soils on benches along streams that developed in loamy, dark-colored alluvium of Recent geologic age. These soils are fairly extensive in the river valleys of the county. Textural differences of the horizons are less distinct than color differences.

The Canadian soils are darker than the Reinach soils and more deeply leached of lime. They are also more deeply leached of lime than the Dale soils and have a thinner, sandier, lighter colored A1 horizon.

Profile of Canadian fine sandy loam in a cultivated field on slopes of 0 to 1 percent (west side of road, about 400 feet north of the southeast corner of sec. 1, T. 15 N., R. 11 W.):

A1—0 to 16 inches, brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; medium acid; gradual boundary; horizon 14 to 18 inches thick.

B2—16 to 28 inches, dark-brown (7.5YR 4/4) fine sandy loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; soft when dry, very friable when moist; moderately rapid permeability; slightly acid; gradual boundary; horizon 8 to 14 inches thick.

C—28 to 60 inches +, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/4) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; neutral; gradual boundary.

The A1 horizon is very fine sandy loam or silt loam in small areas. It ranges from dark grayish brown to brown in a hue of 10YR to brown in a hue of 7.5YR. The B2 horizon ranges from dark brown to brown. The C horizon ranges from fine sandy loam to silt loam in texture and from brown in a hue of 7.5YR to dark yellowish brown in a hue of 10YR.

CARWILE SERIES

In the Carwile series are somewhat poorly drained soils that are fairly extensive and occur in shallow swales of the sandy uplands. These soils developed in sandy and loamy material that was derived from Pleistocene sediments. The A1 horizon is dark colored, and the lower horizons are mottled.

The Carwile soils have more distinct layers than the Pratt soils, which are not mottled in the lower layers. Carwile soils have a thinner A1 horizon, a more clayey B horizon, and a thinner solum than Shellabarger soils, but a B1 horizon has not formed. Mottles in the Carwile soils are distinct and are nearer the surface than the faint mottles in the Shellabarger soils.

Profile of a Carwile fine sandy loam in a cultivated field on slopes of 0 to 1 percent (south side of road, about 200 feet west from the northeast corner of the NW¼ of sec. 2, T. 19 N., R. 13 W.):

A1—0 to 8 inches, dark-brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; slightly acid; gradual boundary; horizon 6 to 10 inches thick.

B21t—8 to 16 inches, dark grayish-brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; hard when dry; firm when moist; slightly acid; gradual boundary; horizon 6 to 12 inches thick.

B22t—16 to 32 inches, mottled light-gray (10YR 7/2), strong-brown (7.5YR 5/8), and brown (10YR 5/3) light sandy clay mottles are medium, distinct, and many; moderate, medium, blocky structure; very hard when dry, firm when moist; slow permeability; neutral; gradual boundary; horizon 10 to 20 inches thick.

C—32 to 50 inches +, mottled light-gray (10YR 7/2) and strong-brown (7.5YR 5/8) sandy loam; mottles are coarse, distinct, and many; massive structure; hard when dry, friable when moist; neutral.

In some places the A1 horizon is loam, sandy clay loam, or clay loam. It ranges from dark brown or grayish brown to very dark gray. The B22t horizon ranges from sandy clay loam to sandy clay. Depth to mottling ranges from 14 to 20 inches. The shades and degree of mottling in the B22t horizon vary widely.

DALE SERIES

In the Dale series are well-drained soils on benches along streams. These soils developed in loamy, dark, calcareous alluvium that was derived from silty Pleistocene deposits. They are fairly extensive in the valley of the North Canadian River. Texture is silt loam throughout the profile in most places, but the horizons vary in color.

The Dale soils are not so red as the McLain soils and contain less clay. They are darker and less sandy than the Canadian soils. Dale soils have a darker A1 horizon and a less sandy solum than the Reinach soils.

Profile of Dale silt loam in a cultivated field on slopes of 0 to 1 percent (west side of road, about 2,000 feet south from the northeast corner of sec. 12, T. 14 N., R. 11 W.):

A1—0 to 14 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; medium acid; gradual boundary; horizon 12 to 16 inches thick.

B2—14 to 26 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/4) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; moderate permeability; mildly alkaline; gradual boundary; horizon 10 to 20 inches thick.

C—26 to 70 inches +, brown (10YR 5/3) silt loam, dark yellowish brown (10YR 4/4) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; limy streaks; calcareous; gradual boundary.

The A1 horizon ranges from dark grayish brown to brown in color. It is dominantly silt loam in texture, but in small areas it is loam. The B2 and C horizons range from dark grayish brown to brown in color, and the B2 horizon ranges in places from silt loam to light silty clay loam in texture.

DILL SERIES

In the Dill series are well-drained soils that developed in material that was derived from weakly consolidated sandstone of the Permian red beds. These soils occur in a small acreage on uplands in the northwestern and southern parts of the county.

The Dill soils have a less clayey subsoil and a more weakly developed solum than the Grant or Teller soils. In contrast to the Woodward soils, Dill soils are deeper to sandstone, and are noncalcareous.

Profile of Dill fine sandy loam, 1 to 5 percent slopes, in a formerly tilled field (north side of road, about 300 feet west of the southeast corner of sec. 6, T. 18 N., R. 13 W.):

A1—0 to 10 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; moderate, fine, granular structure; slightly hard when dry, very friable when moist; slightly acid; gradual boundary; horizon 8 to 14 inches thick.

B2—10 to 28 inches, red (2.5YR 4/6) fine sandy loam, dark reddish brown (2.5YR 3/4) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; moderately rapid permeability; slightly acid; gradual boundary; horizon 12 to 20 inches thick.

B3—28 to 40 inches, red (2.5YR 4/8) fine sandy loam, dark red (2.5YR 3/6) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; slightly acid; gradual boundary; horizon 10 to 16 inches thick.

R—40 to 50 inches +, red (2.5YR 4/6) soft sandstone, dark red (2.5YR 3/6) when moist; slightly acid.

The A1 horizon ranges from dark brown in a hue of 7.5YR to reddish brown in a hue of 5YR. The B2 horizon ranges from red in a hue of 2.5YR to reddish brown in a hue of 5YR. Its texture ranges from fine sandy loam to light loam. Depth to weakly consolidated sandstone ranges from 24 to 48 inches.

FARNUM SERIES

In the Farnum series are nearly level to very gently sloping, well-drained soils of the uplands. These soils developed in material that was derived from loamy and silty Pleistocene sediments. They occur in a small acreage in the northwestern part of the county.

The Farnum soils have a sandier A1 horizon and a thicker B1 horizon than the St. Paul or Bethany soils.

Profile of Farnum fine sandy loam, 0 to 3 percent slopes, in a cultivated field (south side of road, about 200 feet east of the northwest corner of sec. 6, T. 17 N., R. 13 W.):

A1—0 to 12 inches, brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; slightly acid; gradual boundary; horizon 10 to 15 inches thick.

A3—12 to 24 inches, dark-brown (7.5YR 4/4) loam, dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; neutral; gradual boundary; horizon 12 to 20 inches thick.

B2t—24 to 46 inches, dark-brown (7.5YR 4/4) heavy clay loam, dark brown (7.5YR 3/2) when moist; moderate, medium, blocky structure; very hard when dry, firm when moist; clay films on peds; slowly permeable; mildly alkaline; gradual boundary; horizon 18 to 26 inches thick.

B3—46 to 60 inches +, dark grayish-brown (10YR 4/2) clay loam, mottled with strong brown (7.5YR 5/6); mottles are common, medium, and distinct; moderate, medium, blocky structure; very hard when dry, firm when moist; neutral.

The A1 horizon is loam in some places and ranges from brown to dark brown. The B2t and B3 horizons range from dark brown to dark grayish brown. The B2t horizon ranges from clay loam to light clay.

GRANT SERIES

The Grant series consists of well-drained soils of the uplands. These soils developed in material derived from silty Permian red beds or from Pleistocene sediments. They occur in a fairly large acreage in the south-central and southeastern parts of the county.

The Grant soils have a less clayey B2t horizon than the Kingfisher or the Renfrow soils. They are more strongly developed than the Dill soils and contain more clay throughout their profile. Grant soils contain more silt and less sand than the Teller soils.

Profile of Grant silt loam, 1 to 3 percent slopes, in a cultivated field (north side of road, about 600 feet east of the southwest corner of sec. 34, T. 14 N., R. 11 W.):

A1—0 to 12 inches, dark-brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; slightly acid; gradual boundary; horizon 8 to 14 inches thick.

B1—12 to 22 inches, reddish-brown (5YR 4/4) heavy silt loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; neutral; gradual boundary; horizon 8 to 12 inches thick.

B2t—22 to 34 inches, reddish-brown (5YR 4/4) light silty clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; moderate permeability; neutral; gradual boundary; horizon 10 to 14 inches thick.

B3—34 to 52 inches, red (2.5YR 4/6) light silty clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; neutral; gradual boundary; horizon 12 to 20 inches thick.

C—52 to 60 inches +, red (2.5YR 4/8) silt loam, dark red (2.5YR 3/6) when moist; moderate, fine, granular structure; soft when dry, very friable when moist; neutral; small fragments of partly weathered soft red beds.

The A1 horizon is loam and heavy loam in small areas. It ranges from dark brown in a hue of 7.5YR to reddish brown in a hue of 2.5YR. The B1 and B2t horizons range from reddish brown in a hue of 5YR to red in a hue of 2.5YR. The B2t horizon ranges from heavy silt loam to light silty clay loam. The C horizon is red in most places and consists of partly weathered red beds or Pleistocene sediment.

KINGFISHER SERIES

The Kingfisher series consists of well-drained soils of the uplands. These soils developed from silty material that was derived from Permian red beds. They occur inextensively in the northeastern part of the county.

The Kingfisher soils have a thicker A1 horizon and a less clayey B2t horizon than the Renfrow soils and a more clayey B2t horizon than the Grant.

Profile of Kingfisher silt loam, 0 to 1 percent slopes, in a cultivated field (east side of road, about 400 feet north of the southwest corner of sec. 10, T. 19 N., R. 10 W.):

A1—0 to 12 inches, reddish-brown (5YR 4/3) silt loam, dark reddish brown (5YR 3/3) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; medium acid; gradual boundary; horizon 10 to 14 inches thick.

B1—12 to 18 inches, reddish-brown (5YR 4/3) heavy silt loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; hard when dry, friable when moist; slightly acid; gradual boundary; horizon 4 to 8 inches thick.

B21t—18 to 22 inches, reddish-brown (2.5YR 4/4) light silty clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; neutral; gradual boundary; horizon 4 to 8 inches thick.

B22t—22 to 30 inches, reddish-brown (2.5YR 4/4) heavy silty clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; slowly permeable; neutral; gradual boundary; horizon 6 to 10 inches thick.

B3—30 to 44 inches, red (2.5YR 4/6) light clay loam, dark red (2.5YR 3/6) when moist; moderate, fine, granular structure; hard when dry, friable when moist; few fragments of sandstone and shale; neutral; gradual boundary.

R—44 to 60 inches +, red (2.5YR 4/6) and dark-red (2.5YR 3/6) red beds; calcareous along bedding planes.

The A1 horizon ranges from reddish brown to dark reddish brown. The B1, B21t, and B22t horizons range from reddish brown in a hue of 5YR or 2.5YR to dark reddish brown in a hue of 2.5YR. The B22t horizon is silty clay loam or heavy silty clay loam. Depth to the R horizon is more than 42 inches.

KIRKLAND SERIES

In the Kirkland series are well-drained soils that developed from silty soil material in the uplands. These soils occur in a small acreage in the northeastern part of

the county. They have a thick, dark-colored, granular A1 horizon and a dark-brown clay B2t horizon.

The Kirkland soils have a darker solum than the Renfrow. The A horizon of Kirkland soils is not so thick as that of the Bethany soils, which have a B1 horizon that Kirkland soils lack. Kirkland soils have a less gray A horizon than the Tabler soils and a lighter colored B2 horizon.

Profile of Kirkland silt loam, 0 to 1 percent slopes, in a cultivated field (east side of road, about 700 feet north of the southwest corner of sec. 12, T. 19 N., R. 11 W.):

A1—0 to 10 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; hard when dry, friable when moist; slightly acid; clear boundary; horizon 8 to 12 inches thick.

B2t 10 to 26 inches, dark-brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) when moist; moderate, medium, blocky structure; very hard when dry, firm when moist; very slowly permeable; mildly alkaline; gradual boundary; horizon 14 to 20 inches thick.

B3—26 to 38 inches, dark-brown (7.5YR 4/4) heavy silty clay loam, dark brown (7.5YR 3/2) when moist; weak, medium, blocky structure; very hard when dry, firm when moist; mildly alkaline; gradual boundary; horizon 10 to 16 inches thick.

C—38 to 60 inches +, yellowish-red (5YR 4/6) heavy silty clay loam, dark reddish brown (5YR 3/4) when moist; massive; very hard when dry, firm when moist; calcareous.

The A1 horizon is light silty clay loam in small areas. It ranges from dark brown in a hue of 7.5YR to dark grayish brown in a hue of 10YR. The B2t horizon ranges from clay to light clay in texture and from dark brown to brown in color. The B3 horizon ranges from heavy silty clay loam to clay in texture and from brown in a hue of 7.5YR to dark reddish brown in a hue of 5YR. The C horizon ranges from dark red in a hue of 2.5YR to yellowish red in a hue of 5YR. Depth to calcareous material ranges from 32 to 38 inches.

KONAWA SERIES

The Konawa series consists of somewhat excessively drained sandy soils of the wooded uplands. These soils developed from thick, sandy material that was derived from Pleistocene sediment. They support a thick stand of blackjack oak. Konawa soils are in the central, west-central, and southeastern parts of the county. Their darkened A1 horizon overlies a leached A2 horizon.

The Konawa soils have a sandier A1 horizon and a more distinct light-colored A2 horizon than the Shellabarger soils. The B2t horizon of the Konawa soils is more developed than that of the Nobscot soils and contains more clay.

Profile of Konawa loamy fine sand, hummocky, under blackjack oaks (west side of road, about 100 feet north of the southeast corner of sec. 29, T. 15 N., R. 10 W.):

A1—0 to 6 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; slightly acid; clear boundary; horizon 6 to 12 inches thick.

A2—6 to 12 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) when moist; single grain, loose; slightly acid; clear boundary; horizon 6 to 16 inches thick.

B2t—12 to 28 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) when moist; massive; hard when dry, friable when moist; moderate permeability; medium acid; gradual boundary; horizon 14 to 20 inches thick.

B31—28 to 40 inches, yellowish-red (5YR 5/8) sandy loam, yellowish red (5YR 4/8) when moist; weak, very fine, granular structure; soft when dry, friable when moist; medium acid; gradual boundary; horizon 9 to 14 inches thick.

B32—40 to 60 inches +, yellowish-red (5YR 5/8) loamy fine sand, yellowish red (5YR 4/8) when moist; single grain; loose; bands of red (2.5YR 4/6) light sandy clay loam, dark red (2.5YR 3/6) when moist; ¼ to ½ inch thick; medium acid; grades to deep fine sand.

The A1 horizon is fine sand in some cultivated areas. It ranges from brown to dark grayish brown. The A2 horizon ranges from fine sand to loamy fine sand in texture and from light brown in a hue of 7.5YR to yellowish brown in a hue of 10YR. The B2t horizon ranges from heavy fine sandy loam to sandy clay loam in texture and from red in a hue of 2.5YR to yellowish red in a hue of 5YR.

LELA SERIES

The Lela series consists of somewhat poorly drained soils of the bottom lands. These soils developed in fine-textured, dark-colored, calcareous alluvium of Recent geologic age. They occur in a small acreage, mostly in the valley of the North Canadian River.

The Lela soils contain more clay throughout their profile than the Leshara and other associated soils of the bottom lands.

Profile of Lela clay, wet, in a cultivated field on slopes of 0 to 1 percent (south side of road, about 1,300 feet west from the northeast corner of sec. 3, T. 18 N., R. 13 W.):

A1—0 to 24 inches, dark-gray (10YR 4/1) clay, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; very hard when dry, firm when moist; very slow permeability; calcareous; gradual boundary; horizon 18 to 28 inches thick.

B—24 to 36 inches +, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; weak, medium, blocky structure; extremely hard when dry, firm when moist; calcareous; water table at depth of 30 inches.

The A1 horizon is clay loam, silty clay loam, or silty clay in small areas. It ranges from dark gray to very dark grayish brown. The B horizon ranges from gray to very dark gray. It is clay in most places but is silty clay in some areas. In some areas below Canton Dam, a thin white crust is apparent. Depth to the water table ranges from 28 to 40 inches.

LESHARA SERIES

In the Leshara series are somewhat poorly drained, calcareous soils of the bottom lands. These soils developed in mixed sandy and loamy alluvium on the low terraces of the flood plains in the river valleys. They are subject to occasional flooding.

The Leshara soils have a siltier, darker colored B horizon than Wann soils and a much less clayey profile than the Lela.

Profile of Leshara fine sandy loam in a cultivated field on slopes of 0 to 1 percent (west side of road, about 1,200 feet south of the northeast corner of sec. 25, T. 16 N., R. 12 W.):

A1—0 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; calcareous; gradual boundary; horizon 8 to 14 inches thick.

B—10 to 32 inches, gray (10YR 5/1) loam, dark gray (10YR 4/1) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; moderate permeability; common, fine, distinct mottles below depth of 24 inches; calcareous; gradual boundary; horizon 14 to 26 inches thick.

C—32 to 60 inches +, light yellowish-brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) when moist; massive; soft when dry, very friable when moist; calcareous; water table at depth of 36 inches.

The A1 horizon is silt loam in small areas. It ranges from grayish brown to very dark grayish brown. The B horizon ranges from gray to very dark gray in color and from loam to silt loam or light silty clay loam in texture. The C horizon ranges from light yellowish brown in a hue of 10YR to brown in a hue of 7.5YR. Texture of this horizon ranges from loamy fine sand to fine sandy loam. Depth to the sandy substratum is more than 24 inches.

LINCOLN SERIES

The Lincoln series consists of calcareous, well-drained soils of the bottom lands that are subject to frequent flooding. These soils developed in mixed sandy and loamy alluvium in the low flood plains of the river valleys. Lincoln soils have a dark-colored loamy fine sand A1 and a loamy sand AC horizon over water-sorted sand.

The Lincoln soils are not so red as the Yahola soils and are coarser textured in the upper layers and shallower to stratified alluvial sand. They are sandier and better drained than Wann or Leshara soils and have a thinner solum.

Profile of Lincoln loamy fine sand in a cultivated field on slopes of 0 to 1 percent (south side of road, about 800 feet south and 700 feet east of the northwest corner of sec. 26, T. 18 N., R. 13 W.):

A1—0 to 12 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist; calcareous; gradual boundary; horizon 8 to 16 inches thick.

AC—12 to 18 inches, pale-brown (10YR 6/3) loamy sand, brown (10YR 5/3) when moist; structureless; loose; rapid permeability; stratified with fine sandy loam; calcareous; gradual boundary; horizon 6 to 10 inches thick.

C—18 to 60 inches +, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) when moist; single grain; loose; stratified; calcareous.

The A1 horizon is fine sand and light fine sandy loam in small areas. It ranges from brown to grayish brown or dark brown. The AC horizon ranges from pale brown in a hue of 10YR to light brown in a hue of 7.5YR. Depth to fine sand or sand ranges from 14 to 24 inches.

LUCIEN SERIES

The Lucien soils developed in material derived from the weakly consolidated sandstone of the upper Permian red beds. These soils of the uplands are in a landscape where moderately steep slopes and canyonlike areas are dominant. They occur in the western and southwestern parts of the county.

The Lucien soils are shallower than the Dill, sandier than the Vernon, and more acid than the Quinlan soils.

Profile of Lucien fine sandy loam in wooded rangeland on a steep slope (south side of road, about 500 feet east of the northwest corner of sec. 26, T. 16 N., R. 13 W.):

A1—0 to 10 inches, reddish-brown (5YR 4/3) fine sandy loam, dark reddish brown (5YR 3/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist; many fine roots and pores; neutral; gradual boundary; horizon 6 to 12 inches thick.

B—10 to 16 inches, red (2.5YR 4/6) fine sandy loam, dark red (2.5YR 3/6) when moist; weak, fine, granular structure; soft when dry, very friable when moist; few fine roots and pores; neutral; gradual boundary; horizon 0 to 8 inches thick.

R—16 to 24 inches +, red (2.5YR 4/6), dark red (2.5YR 3/6) when moist; slightly acid; soft sandstone.

The A1 horizon is very fine sandy loam and loam in places. It ranges from reddish brown to dark reddish brown in a hue of 5YR to red in a hue of 2.5YR. Depth to the red beds ranges from 6 to 20 inches.

McLAIN SERIES

The McLain series consists of well-drained soils on benches along streams. These soils formed in reddish-brown, calcareous alluvium that was washed from Permian red beds. The horizons of McLain soils vary distinctly in color. These soils are mostly in the northeastern part of the county.

The McLain soils have a darker A1 horizon than the Port soils, which lack a B2t horizon. McLain soils are darker colored and finer textured than the Yahola soils and have a thicker A1 horizon. Also, their substratum is finer textured than that of the Yahola soils, and flooding is much less likely.

Profile of a McLain silty clay loam in a cultivated field on slopes of 0 to 1 percent (east side of road, about 2,200 feet north of the southwest corner of sec. 30, T. 18 N., R. 10 W.):

A1—0 to 12 inches, dark-brown (7.5YR 4/3) silty clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, firm when moist; neutral; gradual boundary; 10 to 14 inches thick.

B2t—12 to 30 inches, reddish-brown (5YR 4/3) heavy silty clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, subangular blocky structure; very hard when dry, firm when moist; slowly permeable; moderately alkaline; gradual boundary; 15 to 25 inches thick.

C—30 to 60 inches +, reddish-brown (2.5YR 4/4) silty clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, medium, granular structure; very hard when dry, firm when moist; calcareous.

The A1 horizon is clay loam or silt loam in small areas. It ranges from dark brown in a hue of 7.5YR to dark grayish brown in a hue of 10YR. The B2t horizon ranges from reddish brown in a hue of 5YR to red in a hue of 2.5YR. Texture of the B2t horizon ranges from silty clay loam to light clay.

MILES SERIES

The Miles series consists of well-drained loamy soils of the uplands. These soils developed in thick sandy material that was derived from Pleistocene deposits. They are in the extreme west-central part of the county. Their A1 horizon is a thick, dark-colored layer over lighter colored, finer textured B1 and B2t horizons.

The Miles soils are more strongly developed than the Dill soils and contain more clay in their profile. They are not so dark as the Shellabarger and are yellowish red instead of strong brown and reddish yellow in the B3 and C horizons. The A1 horizon is less sandy than that of the Konawa and Nobscot soils, and an A2 horizon is missing.

Profile of Miles fine sandy loam, 1 to 3 percent slopes, in native range (east side of road, about ½ mile north of the southwest corner of sec. 6, T. 18 N., R. 13 W.) :

A1—0 to 12 inches, dark-brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; about neutral; gradual boundary; horizon 8 to 14 inches thick.

B1—12 to 20 inches, reddish-brown (5YR 4/4) light sandy clay loam, dark reddish brown (5YR 3/4) when moist; coarse prismatic and weak, fine, subangular blocky structure; hard when dry, friable when moist; about neutral; gradual boundary; horizon 6 to 10 inches thick.

B2t—20 to 32 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) when moist; coarse prismatic and moderate, medium, subangular blocky structure; hard when dry, firm when moist; moderate permeability; neutral; gradual boundary; horizon 10 to 16 inches thick.

B31—32 to 50 inches, yellowish-red (5YR 5/8) light sandy clay loam, yellowish red (5YR 4/8) when moist; weak, fine, subangular blocky structure or massive; hard when dry, friable when moist; neutral; gradual boundary; horizon 15 to 25 inches thick.

B32—50 to 60 inches +, red (2.5YR 5/8) light sandy clay loam, red (2.5YR 4/8) when moist; weak, fine, subangular blocky structure or massive; hard when dry, friable when moist; neutral.

The A1 horizon is dominantly fine sandy loam, but in plowed areas there is some loamy fine sand. This horizon ranges from dark brown in a hue of 7.5YR to brown in hue of 10YR. The B1 and B2t horizons range from reddish brown in a hue of 5YR to brown in a hue of 7.5YR. Texture of the B3 horizon ranges from light sandy clay loam to clay loam.

MINCO SERIES

The loamy Minco soils developed in several feet of alkaline to weakly calcareous eolian silts and very fine sands that are over Permian red beds. Most areas of these soils are near and along the South Canadian River and north and east of the Hydro community.

The Minco soils have a less clayey subsoil and a less distinct profile than the nearby Vanoss and Teller soils.

Profile of Minco loam, 0 to 1 percent slopes, in a cultivated field (north side of road, about ½ mile north and ¼ mile east of the southwest corner of sec. 31, T. 13 N., R. 12 W.) :

A1—0 to 24 inches, dark-brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; neutral; gradual boundary; horizon 18 to 32 inches thick.

B2—24 to 50 inches, dark-brown (7.5YR 4/4) loam, dark brown (7.5YR 3/4) when moist; weak, fine, granular structure; soft when dry, friable when moist; moderate permeability; mildly alkaline; gradual boundary; horizon 20 to 30 inches thick.

C—50 to 60 inches +, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; calcareous.

The A1 and B2 horizons range from dark brown to brown. The C horizon ranges from reddish brown in a hue of 5YR to brown in a hue of 7.5YR. Texture of the C horizon ranges from fine sandy loam to loam.

Profile of Minco very fine sandy loam, 3 to 8 percent slopes, in native range (north side of road, about 1,800 feet west of the southeast corner of the NE¼ of sec. 27, T. 13 N., R. 12 W.) :

A1—0 to 18 inches, dark-brown (7.5YR 4/2) very fine sandy loam, dark brown (7.5YR 3/2) when moist; weak, very fine, granular structure; very friable when moist, soft when dry; mildly alkaline; gradual boundary; horizon 18 to 24 inches thick.

B2—18 to 30 inches, yellowish-red (5YR 5/6) very fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; moderately rapid permeability; mildly alkaline; gradual boundary; horizon 12 to 16 inches thick.

C—30 to 50 inches +, reddish-yellow (5YR 6/6) very fine sandy loam, yellowish red (5YR 4/6) when moist; weak, fine, granular structure; soft when dry, very friable when moist; mildly alkaline.

The A horizon is fine sandy loam in small areas. It ranges from dark brown to brown. The B2 horizon ranges from yellowish red in a hue of 5YR to dark brown in a hue of 7.5YR. Its texture is very fine sandy loam or loam. The C horizon ranges from reddish yellow in a hue of 5YR to dark brown in a hue of 7.5YR. It is sandy loam in places.

NOBSCOT SERIES

The Nobscot series consists of somewhat excessively drained, sandy soils of the wooded uplands in the central, west-central, and southwestern parts of the county. These soils developed in thick, sandy, weathered Pleistocene sediment under a thick stand of blackjack oak and some tall grasses. They have a thin, dark A1 horizon and a leached A2 horizon over a B2t horizon that is irregularly banded with reddish sandy loam.

The B2t horizon of the Nobscot soils is less clayey than that of the Konawa soils. It is banded, and the B2t horizon of the Konawa soils is not. Unlike the Pratt soils, the Nobscot soils have an A2 horizon and a banded B2t horizon.

Profile of Nobscot fine sand, hummocky, in woodland consisting of blackjack oak (east side of road, about ¾ mile south of the northwest corner of sec. 9, T. 18 N., R. 12 W.) :

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) fine sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose; many fine roots; slightly acid; clear boundary; horizon 4 to 8 inches thick.

A2—4 to 22 inches, yellowish-brown (10YR 5/4) fine sand, dark yellowish brown (10YR 4/4) when moist; single grain; loose; medium acid; clear boundary; horizon 6 to 16 inches thick.

B2t—22 to 32 inches, yellowish-red (5YR 5/6) sandy loam, yellowish red (5YR 4/6) when moist; weak, fine, granular structure; hard when dry, friable when moist; moderate to moderately rapid permeability; bands ½ inch to 2 inches thick or red (2.5YR 4/6) light sandy clay loam, dark red (2.5Y 3/6) when moist; medium acid; gradual boundary; 10 to 20 inches thick.

C—32 to 60 inches +, yellowish-red (5YR 5/8) loamy sand, yellowish red (5YR 4/8) when moist; single grain; loose; medium acid; grades into deep fine sand.

In some places where the native vegetation remains, the A1 and A2 horizons are loamy fine sand and are darker than the horizon described. The A1 horizon ranges from brown to dark grayish brown, and the A2 horizon from pale brown to yellowish brown. The B2t horizon ranges from reddish brown to yellowish red in color, and from sandy loam to heavy sandy loam in texture. The bands in the B2t horizon range from ½ to 3 inches in thickness, and from dark reddish brown in a hue of 5YR to red in a hue of 2.5YR. The bands range from sandy loam to light clay loam.

NORGE SERIES

In the Norge series are well-drained, nearly level to strongly sloping soils that developed on high terraces in weathered loamy and silty Pleistocene deposits. These soils occur in a small acreage in the northeastern part of the county. They have a dark A1 horizon over a reddish clay loam B horizon.

The Norge soils are redder than the Shellabarger soils and contain more clay in the lower horizons. They are more clayey and less friable than the Teller soils. Norge soils are deeper and more silty than the Kingfisher soils and developed on high terraces instead of in weathered red beds of shale and sandstone.

Profile of Norge loam, 0 to 1 percent slopes, in a cultivated field (north side of road, about 500 feet west of the southeast corner of the SW¼ of sec. 27, T. 19 N., R. 11 W.):

A1—0 to 12 inches, dark-brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; hard when dry, friable when moist; slightly acid; gradual boundary; horizon 8 to 14 inches thick.

B1—12 to 20 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; neutral; gradual boundary; horizon 6 to 10 inches thick.

B2t—20 to 34 inches, reddish-brown (5YR 4/4) heavy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; slow permeability; mildly alkaline; gradual boundary; horizon 12 to 20 inches thick.

B31—34 to 46 inches, red (2.5YR 5/6) light clay loam, dark red (2.5YR 3/6) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; mildly alkaline; gradual boundary; horizon 8 to 14 inches thick.

B32—46 to 60 inches +, red (2.5YR 5/6) light clay loam, dark red (2.5YR 3/6) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; calcareous.

The A1 horizon is fine sandy loam in some places. It ranges from brown to dark brown and has a hue of 7.5YR and 10YR. The B horizon ranges from reddish brown in a hue of 5YR to red in a hue of 2.5YR. The B2t horizon ranges from heavy clay loam to silty clay loam.

PORT SERIES

In the Port series are well-drained, nearly level soils of the bottom lands, mostly in the northeastern part of the county. These soils formed in reddish, calcareous alluvium that was derived from red beds of Permian age and from coarser sediment of Pleistocene age. Horizons differ in color but are of about the same texture from the surface throughout the profile.

Port soils have a redder A1 horizon than the McLain soils and less clayey B and C horizons. The Port are less subject to flooding than the Yahola soils and have a darker, finer textured, thicker A1 horizon and a finer textured C horizon.

Profile of Port clay loam in a cultivated field on slopes of 0 to 1 percent (north side of road, about 1,200 feet east of the southwest corner of sec. 26, T. 18 N., R. 11 W.):

A1—0 to 12 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; hard when dry, firm when moist; moderately alkaline; gradual boundary; horizon 8 to 12 inches thick.

B—12 to 20 inches, red (2.5YR 4/6) clay loam, dark red (2.5YR 3/6) when moist; moderate, medium, granular structure; hard when dry, friable when moist; slow permeability; calcareous; gradual boundary; horizon 8 to 15 inches thick.

C—20 to 60 inches +, red (2.5YR 4/6) light clay loam, dark red (2.5YR 3/6) when moist, weak, fine, granular structure; slightly hard when dry, friable when moist; calcareous.

The A1 horizon is silty clay loam in small areas. It ranges from reddish brown in a hue of 5YR to red in a hue of 2.5YR. The C horizon is dominantly red, but in small areas it is reddish brown. The texture of the C horizon is silty in small areas.

Profile of a Port loam in a cultivated field on 0 to 1 percent slopes (north side of road, about 1,300 feet east of the southwest corner of the NW¼ of sec. 28, T. 18 N., R. 11 W.):

A1—0 to 10 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; mildly alkaline; gradual boundary; horizon 8 to 12 inches thick.

B—10 to 20 inches, reddish-brown (5YR 4/4) heavy loam, dark reddish brown (5YR 3/3) when moist; moderate, fine, granular structure; hard when dry, friable when moist; moderate permeability; moderately alkaline; gradual boundary; horizon 8 to 15 inches thick.

C1—20 to 26 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; calcareous; gradual boundary; horizon 14 to 20 inches thick.

C2—26 to 60 inches +, red (2.5YR 4/6) clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, fine, granular structure; hard when dry, firm when moist; calcareous.

The A1 horizon is silt loam in small areas. It ranges from reddish brown in a hue of 5YR to dark brown in a hue of 7.5YR. The C horizon ranges from reddish brown in a hue of 5YR to red in a hue of 2.5YR. It becomes redder and sandier as depth increases.

PRATT SERIES

The Pratt series consists of somewhat excessively drained sandy soils of the uplands, mostly in the northwestern part of the county. These soils developed under a good cover of tall grasses from thick, sandy weathered deposits of Pleistocene age. They have a thick, dark-colored A1 horizon over a weakly developed B2 horizon.

The Pratt soils are sandier and have a more weakly developed profile than the Shellabarger soils. Pratt soils lack an A2 horizon, which is present in the Nobscot

soils. These soils have a weakly developed B2t horizon, but the noncoherent Tivoli soils do not.

Profile of Pratt loamy fine sand, undulating, in cultivated field (south side of road, about 1,300 feet west and 500 feet south of the northeast corner of sec. 23, T. 19 N., R. 13 W.):

A1—0 to 10 inches, dark-brown (10YR 4/3) loamy fine sand, dark brown (10YR 3/3) when moist; structureless; loose; neutral; gradual boundary; horizon 8 to 12 inches thick.

B2t—10 to 18 inches, dark-brown (10YR 4/3) light fine sandy loam, dark brown (10YR 3/3) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; neutral; gradual boundary; horizon 7 to 16 inches thick.

C—18 to 50 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) when moist; structureless; loose; neutral.

The A1 horizon ranges from grayish brown to dark brown. The B2 horizon ranges from dark brown to yellowish brown and is light fine sandy loam or fine sandy loam. The C horizon is loamy fine sand or sand several feet thick.

QUINLAN SERIES

The Quinlan series consists of shallow, reddish, somewhat excessively drained soils of the uplands, mostly in the western and southern parts of the county. These soils formed in weathered material that was derived from weakly cemented sandstone of the Permian red beds. They occur mostly in moderately steep areas along broken drainageways and canyons.

Quinlan soils are shallower than the Dill, Vernon, and Woodward soils and have a more alkaline profile than the Lucien soils.

Profile of a Quinlan loam in idle land on a steep slope (south side of road, about 1,300 feet east of the northwest corner of sec. 20, T. 19 N., R. 13 W.):

A1—0 to 10 inches, yellowish-red (5YR 4/6) loam, dark reddish brown (5YR 3/4) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; calcareous; gradual boundary; horizon 8 to 14 inches thick.

R—10 to 15 inches +, red (2.5YR 4/8), weakly consolidated, calcareous sandstone.

The A1 horizon is fine sandy loam or very fine sandy loam in small areas. It ranges from yellowish red in a hue of 5YR to red in a hue of 2.5YR. Depth to calcareous red beds ranges from 6 to 20 inches.

REINACH SERIES

The Reinach series consists of well-drained soils on nearly level benches along the South Canadian River. These young soils developed in reddish alluvium that washed from the soft sandstone of the Permian red beds.

The Reinach soils are redder than the Canadian soils and are sandier than the Port. They lie a few feet higher than the Yahola soils, which are on flood plains. They have a slightly darker surface layer than the Yahola soils and are deeper to stratified sands.

Profile of Reinach very fine sandy loam in a cultivated field on slopes of 0 to 1 percent (north side of road, about the center of sec. 36, T. 13 N., R. 11 W.):

A1—0 to 14 inches, reddish-brown (5YR 4/3) very fine sandy loam, dark reddish brown (5YR 3/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist; moderately alkaline; gradual boundary; horizon 12 to 20 inches thick.

B2—14 to 40 inches, yellowish-red (5YR 5/6) very fine sandy loam, yellowish red (5YR 4/6) when moist; weak, fine, granular structure; soft when dry, very friable when moist; moderate permeability; calcareous; gradual boundary; horizon 12 to 26 inches thick.

C—40 to 60 inches +, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) when moist; calcareous; weakly stratified.

The A1 horizon is fine sandy loam or silt loam in small areas. It ranges from reddish brown in a hue of 5YR to dark brown in a hue of 7.5YR. The B2 horizon has a hue of 5YR and ranges from dark reddish brown to yellowish red. The C horizon ranges from dark reddish brown to yellowish red in color and from fine sandy loam to very fine sandy loam in texture.

RENFROW SERIES

In the Renfrow series are well-drained soils that occur in the uplands of the northeastern part of the county. These soils developed in material that was derived from red shales and clays of the Permian red beds. They have a moderately fine textured A1 horizon and a B2t horizon of reddish-brown clay.

The Renfrow soils have a thicker more strongly developed solum than the Vernon soils and redder A1 and B2t horizons than the Kirkland soils. They have a more clayey B2t horizon than that of the Kingfisher soils.

Profile of Renfrow silty clay loam, 0 to 1 percent slopes, in a cultivated field (east side of road, about 300 feet north of the southwest corner of sec. 17, T. 19 N., R. 10 W.):

A1—0 to 10 inches, reddish-brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) when moist; moderate, fine, granular structure; hard when dry, friable when moist; neutral; gradual boundary; horizon 8 to 12 inches thick.

B2t—10 to 26 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) when moist; weak, medium, blocky structure; very hard when dry, firm when moist; very slowly permeable; neutral; gradual boundary; horizon 12 to 20 inches thick.

B3—26 to 50 inches, dark reddish-brown (2.5YR 3/4) clay, dark red (2.5YR 3/6) when moist; massive; very hard when dry, very firm when moist; calcareous; few small concretions of lime; gradual boundary; horizon 20 to 26 inches thick.

C—50 to 60 inches +, partially weathered shale in red beds, dark red (2.5YR 3/6) when moist; massive; calcareous.

The A1 horizon is clay loam in small areas. It ranges from reddish brown in a hue of 5YR to dark brown in a hue of 7.5YR. The B2t horizon is reddish brown or dark reddish brown. As depth increases, the B3 and C horizons become redder. Depth to clay is less than 12 inches.

SHELLABARGER SERIES

The Shellabarger series consists of well-drained soils of the sandy uplands. These soils developed in deep, loamy or sandy material that was derived from Pleistocene deposits. The vegetation consists of a thick cover of tall grasses. Shellabarger soils cover extensive areas in the central, western, and southern parts of the county. They have a thick, dark-colored, loamy A1 horizon and a thick, dark-colored, loamy B2t horizon.

The Shellabarger soils are more strongly developed than the Pratt soils and contain more clay throughout their profile. They contain more sand and less silt than

the Teller soils and have a darker colored, less clayey subsoil than the Norge soils.

Profile of Shellabarger fine sandy loam, 0 to 3 percent slopes, in a cultivated field (south side of road, about 1,500 feet east of the northwest corner of sec. 21, T. 16 N., R. 11 W.):

A1—0 to 12 inches, dark-brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; slightly acid; clear boundary; horizon 10 to 16 inches thick.

B1—12 to 22 inches, dark-brown (7.5YR 4/4) light sandy clay loam, dark brown (7.5YR 3/2) when moist; weak, fine, subangular blocky structure; slightly hard when dry, firm when moist; slightly acid; gradual boundary; horizon 6 to 10 inches thick.

B2t—22 to 34 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; neutral; gradual boundary; horizon 8 to 14 inches thick.

B3—34 to 46 inches, strong-brown (7.5YR 5/6) heavy sandy loam, dark brown (7.5YR 4/4) when moist; weak, fine, granular structure; soft when dry, very friable when moist; neutral; gradual boundary; horizon 8 to 16 inches thick.

C—46 to 60 inches +, reddish-yellow (7.5YR 6/6) sandy loam, strong brown (7.5YR 5/6) when moist; few, fine, faint mottles of yellowish red (5YR 5/8); massive; soft when dry, very friable when moist; neutral.

The A1 horizon is dominantly fine sandy loam, but there is some loamy fine sand in the plow layer. The A1 horizon ranges from brown in a hue of 7.5YR to dark brown in a hue of 10YR. The B horizon ranges from dark brown in a hue of 7.5YR to yellowish brown in a hue of 10YR. Texture of the B2t horizon ranges from clay loam to heavy sandy clay loam. The C horizon ranges from reddish yellow in a hue of 7.5YR to yellowish brown in a hue of 10YR. It ranges from sandy loam to loamy fine sand in texture.

ST. PAUL SERIES

In the St. Paul series are well-drained extensive soils of the uplands in the northwestern part of the county. These soils developed on high terraces in silty material that was derived from Pleistocene sediment. They have a thick, dark-colored, granular A1 horizon, a friable B1 horizon, and a firm B2t horizon.

In the St. Paul soils, the A1 horizon is lighter colored and thinner than that of the Bethany soils, the B1 horizon is thicker, and the B2t horizon is less clayey. The B2t horizon of St. Paul soils is more clayey than that of the Vanoss soils.

Profile of St. Paul silt loam, 0 to 1 percent slopes, in a cultivated field (north side of road, about ½ mile west of the southeast corner of sec. 21, T. 16 N., R. 12 W.):

A1—0 to 12 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; neutral; gradual boundary; horizon 10 to 14 inches thick.

B1—12 to 22 inches, dark-brown (7.5YR 4/4) light silty clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; mildly alkaline; gradual boundary; horizon 8 to 14 inches thick.

B2t—22 to 36 inches, dark-brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; slowly permeable; mildly alkaline; gradual boundary; horizon 12 to 20 inches thick.

B3—36 to 50 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; hard when dry, firm when moist; mildly alkaline; gradual boundary; horizon 12 to 18 inches thick.

C—50 to 60 inches +, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) when moist; few, medium, faint mottles of strong brown (7.5YR 5/8); massive; hard when dry, firm when moist; mildly alkaline.

The A1 horizon ranges from brown in a hue of 10YR to dark brown in a hue of 7.5YR. The B2t and B3 horizons range from brown in a hue of 7.5YR to dark brown in a hue of 10YR. The B2t horizon is silty clay loam or heavy silty clay loam, and the B3 and C horizons range from clay loam to silty clay loam. The C horizon ranges from light brown to reddish yellow.

TABLER SERIES

The Tabler series consists of moderately well drained soils in shallow swales of the uplands. These soils developed in silty materials and from weathered Permian red beds. They occur inextensively in the north-central and southeastern parts of the county. Tabler soils have a thick, dark-colored A1 horizon over a thick, dark-colored, clayey B2t horizon.

Tabler soils have a grayer A1 horizon than the Renfrow soils and darker B2t and B3 horizons than the Kirkland and Renfrow soils. In contrast to Bethany soils, Tabler soils lack a B1 horizon and have a thinner A1 horizon and a more clayey B2t horizon.

Profile of Tabler silty clay loam in a cultivated field on slopes of 0 to 1 percent (east side of road, about 2,000 feet south of the northwest corner of sec. 18, T. 19 N., R. 10 W.):

A1—0 to 8 inches, dark grayish-brown (10YR 4/2) light silty clay loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; hard when dry, firm when moist; neutral; clear boundary; horizon 6 to 10 inches thick.

B21t—8 to 25 inches, very dark-gray (10YR 3/1) clay, very dark brown (10YR 2/2) when moist; weak, medium, blocky structure; extremely hard when dry, very firm when moist; neutral to mildly alkaline; gradual boundary; horizon 15 to 24 inches thick.

B22t—25 to 34 inches, dark grayish-brown (10YR 4/2) light clay, dark brown (10YR 3/3) when moist; weak, fine, subangular blocky structure; extremely hard when dry, very firm when moist; weakly calcareous; gradual boundary; horizon 8 to 15 inches thick.

B3—34 to 54 inches +, dark grayish-brown (10YR 4/2) heavy silty clay loam, dark brown (10YR 3/3) when moist; weak, fine, blocky structure; extremely hard when dry, very firm when moist; few fine concretions of lime; calcareous.

The A1 horizon ranges from dark grayish brown to very dark brown in color and from silty clay loam to silt loam in texture. The B2t horizon ranges from very dark gray to very dark brown. The B3 horizon ranges from dark grayish brown to dark brown.

TELLER SERIES

In the Teller series are well-drained soils that occur in the loamy uplands, mostly in the southwestern part of the county. These soils developed under a thick cover

of tall grasses in deep, sandy, weathered deposits of Pleistocene age.

The Teller soils contain more sand and less silt than Grant soils and are redder than the Shellabarger. Teller soils have a less clayey B2t horizon than the Norge soils.

Profile of Teller fine sandy loam, 1 to 3 percent slopes, in a cultivated field (north side of road, about 2,300 feet west of the southeast corner of sec. 30, T. 13 N., R. 13 W.):

A1—0 to 10 inches, reddish-brown (5YR 4/3) fine sandy loam, dark reddish brown (5YR 3/3) when moist; weak, very fine, granular structure; slightly hard when dry, friable when moist; medium acid; gradual boundary; horizon 8 to 12 inches thick.

B1—10 to 16 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, granular structure; hard when dry, friable when moist; medium acid; gradual boundary; horizon 6 to 10 inches thick.

B2t—16 to 40 inches, yellowish-red (5YR 5/6) light clay loam, yellowish red (5YR 4/6) when moist; moderate, medium, granular structure; hard when dry, firm when moist; moderate permeability; slightly acid; gradual boundary; horizon 14 to 26 inches thick.

B3—40 to 60 inches +, yellowish-red (5YR 5/8) fine sandy loam, yellowish red (5YR 4/8) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; slightly acid.

The A1 horizon ranges from fine sandy loam to loam in texture, and from reddish brown in a hue of 5YR to brown in a hue of 7.5YR. The B2t horizon ranges from yellowish red to dark reddish brown in color and from heavy loam to clay loam in texture. The B3 horizon ranges from sandy loam to loam.

TIVOLI SERIES

The Tivoli series consists of light-colored, loose soils that are fine sand from the surface throughout the profile. These soils developed in weathered eolian sand, most of which is of Quaternary age. Soil development is evident only in the upper few inches, which have been darkened by accumulated organic matter. These soils are mostly on large sand dunes that roughly parallel the rivers.

Unlike the Pratt soils, the Tivoli soils are rolling and show only slight profile development.

Profile of Tivoli fine sand, rolling, in a large stabilized sand dune (north side of road, about 300 feet east and 200 feet north of the southwest corner of the SE¼ of sec. 23, T. 16 N., R. 12 W.):

A1—0 to 8 inches, pale-brown (10YR 6/3) fine sand, dark brown (10YR 4/3) when moist; single grain; loose; neutral; gradual boundary; horizon 8 to 10 inches thick.

C—8 to 50 inches +, light yellowish-brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) when moist; single grain; loose; rapidly permeable; neutral.

The A1 horizon ranges from pale brown to grayish brown. The C horizon ranges from very pale brown to light yellowish brown.

VANOSS SERIES

In the Vanoss series are well-drained, nearly level to very gently sloping soils on high terraces, mostly in the southwestern part of the county. These soils developed in loamy and silty weathered deposits of Pleistocene age. They have a thick, dark-colored, friable A1 horizon over a thick, dark-colored clay loam B21t horizon.

Vanoss soils are darker than the Teller soils and have a more friable and less clayey B horizon than the Bethany or the St. Paul soils. Vanoss soils are more strongly developed and have a much more clayey subsoil than the Minco soils.

Profile of Vanoss loam, 0 to 1 percent slopes, in a cultivated field (west side of road, about 1,500 feet south of the northeast corner of sec. 30, T. 16 N., R. 12 W.):

A1—0 to 16 inches, dark-brown (10YR 4/3) loam, dark brown (10YR 3/3) when moist; moderate, fine, granular structure; friable when moist, slightly hard when dry; slightly acid; clear boundary; horizon 10 to 18 inches thick.

B1—16 to 22 inches, dark-brown (10YR 4/3) light clay loam, dark brown (10YR 3/3) when moist; weak, fine, subangular blocky structure; friable when moist, slightly hard when dry; neutral; gradual boundary; horizon 6 to 10 inches thick.

B21t—22 to 28 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 3/3) when moist; weak, fine, sugangular blocky structure; firm when moist, hard, when dry; neutral; clear boundary; horizon 6 to 8 inches thick.

B22t—28 to 40 inches, dark-brown (10YR 4/3) heavy clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; firm when moist, hard when dry; neutral; gradual boundary; horizon 10 to 16 inches thick.

B3—40 to 60 inches +, yellowish-brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) when moist; moderate, medium, subangular blocky structure; firm when moist, hard when dry; neutral.

The A1 horizon is fine sandy loam in small areas. The A1, B1, B21t, and B22t horizons each range from dark brown in a hue of 10YR to brown in a hue of 7.5YR. The B3 horizon ranges from yellowish brown in a hue of 10YR to brown in a hue of 7.5YR. The B21t and B22t horizons each range from clay loam to light silty clay loam. A layer of a buried soil is present in some places.

VERNON SERIES

The Vernon series consists of shallow, reddish, calcareous, very gently sloping or moderately steep soils of the uplands. These soils developed in weathered Permian red beds, mostly in the northeastern part of the county. They have a reddish-brown, loamy A1 horizon that is underlain by a reddish clayey B horizon.

Unlike the Renfrow soils, the Vernon are calcareous throughout the profile, lack a B2t horizon, and have a thin solum. Vernon soils have a more clayey profile than the Lucien or the Quinlan soils.

Profile of Vernon clay loam, 1 to 3 percent slopes, in native grass (north side of road, about 2,300 feet east of the southwest corner of sec. 6, T. 18 N., R. 10 W.):

A1—0 to 8 inches, reddish-brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, fine, granular structure; hard when dry, firm when moist; calcareous; gradual boundary; horizon 6 to 12 inches thick.

B—8 to 17 inches, red (2.5YR 4/6) light clay, dark red (2.5YR 3/6) when moist; moderate, medium, granular structure; hard when dry, firm when moist; slow permeability; calcareous; gradual boundary; horizon 4 to 12 inches thick.

R—17 to 24 inches, reddish-brown (2.5YR 4/4), or dark-red (2.5YR 3/6) when moist, shale, clay, and siltstone of the Permian red beds.

The A1 horizon is silty clay loam in small areas. The A1 and B horizons range from red to reddish brown.

Their hue is 2.5YR or 5YR. The B horizon is light clay loam or clay loam. Depth to the red beds ranges from 10 to 20 inches.

WANN SERIES

The Wann series consists of calcareous, somewhat poorly drained soils of the bottom lands. These soils are mostly on the flood plains of the river valleys and are subject to occasional flooding. They have a dark-colored A1 horizon over a fine sandy loam AC horizon, and they are mottled within 24 inches of the surface.

The Wann soils have a thicker solum than the Lincoln soils and are less sandy and less well drained. They have a sandier, lighter colored AC horizon than the Leshara soils.

Profile of a Wann fine sandy loam in native range on slopes of 0 to 1 percent (east side of road, about 1,400 feet south of the northwest corner of sec. 6, T. 17 N., R. 12 W.):

A1—0 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; soft when dry, very friable when moist; calcareous; gradual boundary; horizon 8 to 14 inches thick.

AC—10 to 22 inches, light yellowish-brown (10YR 6/4) light fine sandy loam, yellowish brown (10YR 5/4) when moist; weak, fine, granular structure; soft when dry, very friable when moist; rapid permeability; calcareous; gradual boundary; horizon 12 to 20 inches thick.

C1—22 to 32 inches, very pale brown (10YR 7/3) light fine sandy loam, brown (10YR 5/3) when moist; few, fine, faint mottles of yellowish brown and grayish brown; weak, very fine, granular structure; calcareous; gradual boundary.

IIC2—32 to 50 inches +, very pale brown (10YR 7/3) sand, brown (10YR 5/3) when moist; single grain; loose; calcareous; stratified; water table at depth of 40 inches.

The A1 horizon ranges from grayish brown to very dark grayish brown in color and from fine sandy loam to loam in texture. The AC horizon ranges from light yellowish brown to dark yellowish brown. Depth to loose sand ranges from 30 to 48 inches.

WOODWARD SERIES

In the Woodward series are reddish soils of the uplands. These soils developed from weathered, weakly consolidated, calcareous sandstone of the Permian red beds.

The Woodward soils are deeper than the Quinlan soils and less clayey than the Grant.

Profile of Woodward loam on moderately steep slopes in native range (south side of road, about 1,000 feet east of the northwest corner of sec. 20, T. 19 N., R. 13 W.):

A1—0 to 10 inches, red (2.5YR 4/6) loam, dark red (2.5YR 3/6) when moist; weak, fine, granular structure; soft when dry, very friable when moist; calcareous; gradual boundary; horizon 8 to 12 inches thick.

B—10 to 18 inches, reddish-brown (2.5YR 4/4) loam, dark reddish brown (2.5YR 3/4) when moist; weak, fine, granular structure; soft when dry, very friable when moist; moderately rapid permeability; calcareous; gradual boundary; horizon 6 to 12 inches thick.

C—18 to 22 inches, red (2.5YR 5/6) loam, red (2.5YR 4/6) when moist; massive; porous; very friable when moist; calcareous; grades into soft sandstone; horizon 2 to 6 inches thick.

R—22 to 26 inches +, red (2.5YR 5/8) weakly consolidated, calcareous sandstone.

The A1 horizon is very fine sandy loam in small areas. It ranges from red in a hue of 2.5YR to reddish brown in a hue of 5YR. The B horizon has about the same color and texture as the A1 horizon but is slightly more clayey and more alkaline. Depth to the red beds is 20 to 30 inches in most places.

YAHOLA SERIES

The Yahola series consists of young soils on occasionally flooded bottom lands along rivers and large creeks. These soils developed in reddish, calcareous alluvium washed from the Permian red beds that are nearby.

Compared to the Port and the Reinach soils, Yahola soils have a redder A1 horizon, a sandier stratified AC horizon, and are more subject to flooding.

Profile of Yahola loam in native range on a slope of 0 to 1 percent (east side of road, about 300 feet south of the northwest corner of sec. 25, T. 18 N., R. 11 W.):

A1—0 to 15 inches, red (2.5YR 4/6) loam, dark reddish brown (2.5YR 3/4) when moist; calcareous; gradual boundary; horizon 10 to 18 inches thick.

AC—15 to 34 inches, red (2.5YR 4/6) sandy loam, dark red (2.5YR 3/6) when moist; weak, fine, granular structure; soft when dry, very friable when moist; moderately rapid permeability; calcareous; stratified; gradual boundary; horizon 10 to 25 inches thick.

IIC—34 to 60 inches +, stratified loose sands; calcareous.

The A1 horizon is silt loam or fine sandy loam in small areas. It ranges from red in a hue of 2.5YR to yellowish red in a hue of 5YR. The AC horizon ranges from fine sandy loam to loamy fine sand but is dominantly sandy loam. Depth to loose sand ranges from 30 to 36 inches. The water table is below 4 feet most of the time.

General Facts About the County

Blaine County, once a part of the Cheyenne and Arapaho Indian Reservation, was opened for settlement by homesteaders in 1892. A large number of the homesteaders came from the Northern States.

This county is in the eastern part of the main wheat belt of the State. It is in the southern part of the tallgrass prairie in the Central Lowland geologic province. Elevation ranges from 1,900 feet in the northwestern part to 1,100 feet in the northeastern part. The Cimarron, North Canadian, and South Canadian Rivers flow southeastward through the county. Watonga, the county seat, is near the center of the county and has an elevation of about 1,500 feet.

Climate [7]

Blaine County, in the west-central part of Oklahoma, has a temperate, continental climate that is dry or subhumid.

Normally, summers are hot, but some relief is provided by occasional showers and by cool nights that have pleasant breezes and low humidity. Although precipitation in summer occurs mostly in thunderstorms, it is generally adequate for growing tame pastures, native grasses, cotton, sorghums, and small grains.

[7] By STANLEY G. HOLBROOK, State climatologist, U.S. Weather Bureau.

Blaine County has an average annual temperature of 61.1°F. The average monthly temperature ranges from 38.4° in January to 83.3° in July. Because the average daily variation is 23.6°, the climate is stimulating. The lowest temperature recorded at Geary was 11° below zero on January 4, 1947, and the highest was 116° on August 12, 1936. On February 13, 1905, at Okeene in the northern part of the county, the temperature fell to 18° below zero, the lowest temperature ever recorded in the county. In table 7 is a summary of data on temperature and precipitation for the period 1931–60.

Most of the annual precipitation occurs during the growing season. Of the annual precipitation, spring and summer each receive 32 percent; fall, 24 percent; and winter, 12 percent. This distribution favors the growth of winter wheat and other fall-sown grain.

The average annual precipitation is lower in the northern part of the county than in the southern part. It is 25.49 inches at Okeene, 26.83 inches at Watonga, and 27.78 inches at Geary. Some are exceptionally wet or dry. In 1941 the total precipitation in the county was 40.33 inches, and in 1956 it was only 14.29.

At Geary for the past 52 years, the average annual snowfall was 10.6 inches. In single years, snowfall has ranged from only a trace in 1922–23 and 1934–35 to 33.5 inches in 1947–48. The most snow to fall in a single day was 12 inches on December 23, 1918.

The average annual evaporation from lakes in Blaine County is 63 inches. Of this amount nearly 70 percent occurs from May to October. According to evaporation data recorded at Canton Dam since 1947, the highest average monthly evaporation from pans occurs during July and averages 11.46 inches. The greatest observed monthly evaporation from pans, however, was 17.69 inches and occurred in August, 1956. Evaporation for the period from April to October varies considerably from year to year. Records at Canton Dam show a range from 46.55 inches in 1961 to 82.89 inches in 1956.

Southerly winds prevail across Blaine County except in January and February, when winds become northwesterly. Windspeed averages about 12.5 miles per hour during July and August and about 15.5 miles per hour during March and April.

The growing season is long enough for most crops. The average freeze-free period ranges from 202 days in the lower areas on the bottom lands to 213 days on the higher uplands. Probabilities of the last specified low temperature in spring and the first in fall are given in table 8. The dates of these specified low temperatures vary widely from year to year. Freezes (32° or lower)

TABLE 7.--TEMPERATURE AND PRECIPITATION IN BLAINE COUNTY, OKLAHOMA

[Based on records kept at Geary, Okla. for the years 1931-60]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with-- Maximum temperature equal to or higher than--	Two years in 10 will have at least 4 days with-- Minimum temperature equal to or lower than--	Average total	One year in 10 will have-- Less than--	One year in 10 will have-- More than--	Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Number	Inches
January----	49.3	27.4	67	8	1.08	0.1	2.7	2	2
February---	53.7	30.7	72	13	1.17	.1	2.2	1	3
March------	61.9	36.9	79	21	1.72	.1	4.0	1	4
April------	72.2	48.2	87	33	2.78	.8	5.7	--	--
May--------	80.0	57.4	94	44	4.40	.9	7.9	--	--
June-------	90.1	67.0	102	57	3.86	1.0	9.1	--	--
July-------	95.5	71.1	105	64	2.35	.6	5.0	--	--
August-----	95.5	70.7	108	62	2.55	.1	4.6	--	--
September--	87.2	62.8	100	50	2.81	(1/)	5.4	--	--
October----	76.2	51.9	91	37	2.53	.2	8.9	--	--
November---	61.2	37.6	77	21	1.26	(2/)	2.6	(3/)	2
December---	51.8	30.3	70	15	1.27	.1	2.9	1	3
Year-----	72.9	49.3	4/ 107	5/ 3	27.78	18.9	38.3	5	3

1/ Less than 0.05 inch.

2/ Trace (too small to measure).

3/ Less than 0.5 day.

4/ Average annual maximum.

5/ Average annual minimum.

have occurred in spring as late as May 3 and in fall as early as November 30. A greater hazard to grain than the early or late freezes are the unseasonably warm periods late in winter. Because grain grows too rapidly during these warm periods, it is damaged by the normal freezes that occur during spring.

Agriculture

Blaine County is mainly agricultural, though the pattern of farming has changed in recent years as the acreage in crops has decreased and the number of livestock increased. Cotton and corn once were the principal crops, but wheat now is the main crop. Also grown are other small grains, sorghums, cotton, and alfalfa.

Crop yields have improved gradually because there has been an increase in general use of improved varieties, in use of modern farm machinery, and in knowledge of tillage. Increase in crop yields, however, cannot continue indefinitely, for cultivating without protecting the soils has accelerated erosion, reduced the content of organic matter, and worsened the structure of the soils. Also, after 70 years of continuous cultivation the fertility of most soils has been lowered.

The sale of livestock and livestock products provides nearly 40 percent of the total farm income of the county. The main kinds of livestock sold are beef cattle, sheep, and hogs. On farms and ranches in 1959 there were about 41,400 cattle and calves, 4,500 hogs and pigs, and 3,300 sheep. Dairy cattle produced only a small part of the income from livestock.

Farm population in Blaine County has decreased steadily, as it has in most other areas where farming is the main enterprise. According to the Federal census, farm population was about 18,500 in 1940, about 15,000 in 1950, and about 12,000 in 1960. The decline in farm population for the period 1940–60 was nearly 35 percent. In 1960 the number of farms in the county was 1,313, and the average size of farms was 418 acres.

Transportation and Industry

Railroads and motor freight lines make markets available to most areas in the county. Public buses provide daily transportation for Watonga, Geary, and Canton. U.S. Highways Nos. 270 and 281 pass through Watonga and Geary as they cross the county in an east-west direction. State Route 33 crosses the central part of the county, and other hard-surfaced roads connect small towns.

Gypsum is mined in the county and is processed at two plants. Also commercially mined are outcrops of sand and gravel on the ridgetops along the north side of the South Canadian River. Petroleum is processed in a single plant, and two natural gaslines cross the county.

Literature Cited

(1) AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 v., illus.

(2) SIMONSON, ROY W.
1962. SOIL CLASSIFICATION IN THE UNITED STATES. Sci. 137: 1027–1034.

(3) SOIL SURVEY STAFF.
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handb. 18, 503 pp., illus.

(4) ———
1960. SOIL CLASSIFICATION, A COMPREHENSIVE SYSTEM. 7th Approximation. U.S. Dept. Agr. 265 pp., illus. [Supplement issued Mar. 1967].

(5) THORP, JAMES AND SMITH, GUY D.
1949. HIGHER CATEGORIES OF SOIL CLASSIFICATION: ORDER, SUBORDER, AND GREAT SOIL GROUP. Soil Sci. 67: 117–126.

(6) UNITED STATES DEPARTMENT OF AGRICULTURE.
1938. SOILS AND MEN. U.S. Dept. Agr. Ybk., 1232 pp., illus.

(7) WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS.
1953. UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo 3–357, 2 v. and app., 48 pp., illus.

TABLE 8.--PROBABILITIES OF LAST FREEZING TEMPERATURES IN SPRING AND FIRST IN FALL

[Data based on records kept at Geary, Okla. for the years 1921-50]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than------	March 20	March 27	March 30	April 9	April 20
2 years in 10 later than-----	March 11	April 21	March 25	April 5	April 15
5 years in 10 later than-----	February 22	March 8	March 17	March 28	April 5
Fall:					
1 year in 10 earlier than----	November 24	November 15	November 6	October 29	October 23
2 years in 10 earlier than---	December 1	November 22	November 12	November 3	October 27
5 years in 10 earlier than---	December 15	December 7	November 24	November 13	November 4

Glossary

Aggregate (soil). Many fine particles held in a single mass or cluster, such as a clod, crumb, block, or prism.
Alkali (soil). Soil affected by saline salts, sodium, or both. A soil affected by saline salts is frequently called "white alkali"; one affected by sodium, "black alkali."
Alluvium. Sand, silt, or clay deposited by streams.
Bedrock. The solid rock underlying soils and other earthy surface formations.
Bottom land. Land bordering streams that may be flooded.
Calcareous soil. A soil containing lime.
Chisel. A tillage machine that has one or more soil-penetrating points that can be drawn through the soil to loosen or shatter the subsoil to a depth of 12 to 18 inches.
Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that contains 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.
Claypan. A dense horizon, containing much clay, and normally very slowly permeable.
Concretions. Rounded and hardened concentrations of chemical compounds, such as calcium carbonate or iron oxides, often formed as concentric rings about a central particle, in the form of hard grains, pellets, or nodules of various sizes, shapes, and colors.
Consistence (soil). The combination of properties of soil material that determines its resistance to crushing and its ability to be molded or changed in shape. Consistence varies with differences in moisture content; thus, a soil aggregate or clod may be hard when dry and plastic when wet. Terms used to describe consistence are:
Friable. When moist, soil crushes easily under moderate pressure between thumb and forefinger and coheres when pressed together. Friable soils are easily tilled.
Firm. When moist, soil crushes under moderate pressure between thumb and forefinger but resistance is distinctly noticeable. Firm soils are likely to be difficult to till.
Hard. When dry, soil is moderately resistant to pressure; can be broken in the hands without difficulty but is barely breakable between thumb and forefinger.
Indurated. Very strongly cemented.
Plastic. When wet, soil retains an impressed shape but is readily deformed by moderate pressure; wire formable. Plastic soils are high in clay and are difficult to till.
Sticky. When wet, soil adheres to thumb and forefinger if pressed; usually very cohesive when dry.
Soft. Weakly coherent and fragile; when dry, soil breaks to powder or individual grains under slight pressure.
Continuous grazing. Grazing without interruption throughout the season.
Contour farming. Conducting plowing, planting, cultivating, harvesting, and other field operations on the contour or at right angles to the natural direction of the slope.
Cropping system. Growing of different crops on the same land, not necessarily in a rigidly defined sequence.
Crust (soil). The hard, brittle layer that forms on many soils when they dry.
Deposition. The accumulation of soil material dropped by wind or water. Alluvial fans, sand dunes, and accumulations at the foot of eroded slopes are examples of deposition.
Diversion terrace. A channel with a supporting ridge on the lower side. It is constructed to intercept runoff, minimize erosion, and prevent excess flow to lower areas.
Dryfarming. Farming in semiarid or arid areas without irrigation; usually involves a system of fallowing and stubble mulching designed to improve the capacity of a soil to absorb and hold moisture.
Fertility (soil). Presence in a soil of necessary elements, in sufficient amounts and proper balance, and available for growth of plants, when other factors, such as light, temperature, and tilth of the soils are favorable.
Field crops. General grain, hay, root, and fiber crops, as contrasted to truck (vegetable) and fruit crops.
Forage. Unharvested plant material available for livestock, which may be grazed or cut for hay.
Grassed waterway. Natural or constructed waterway, typically broad and shallow, covered with grasses that protect the soil from erosion, and used to carry surface water away from cropland.
Grazing capacity. The maximum number of animal units per acre that a grazing area is able to support adequately without deteriorating.
Hardpan (soil). A cemented, or hardened, soil horizon.
Humus. Organic matter that has reached an advanced, more or less stable, stage of decomposition.
Internal drainage (soil). Movement of water through the soil profile. Relative terms used are ***none, very slow, slow, medium, rapid,*** and ***very rapid.***
Leaching. The removal of soluble constituents from soils or other materials by percolating water.
Legume. Cultivated or native plant serving as a host to microorganisms that store nitrogen in nodules on roots of the plants.
Loam. Soil that contains 7 to 27 percent clay, 28 to 50 percent silt, andl ess than 52 percent sand.
Mapping unit. Any area of a kind of soil outlined on the soil map and identified by a symbol.
Organic matter. Plant and animal material, in or on the soil, in all stages of decomposition.
Parent material (soil). The horizon of weathered rock or partially weathered soil material from which the soil was formed.
Pleistocene. The earlier epoch of the Quaternary geologic period or a system of rocks in that epoch. The period preceding the Recent epoch.
Percolation. The downward movement of water through the soil, especially that movement in a soil that is saturated or nearly saturated.
Plow layer. That part of the soil profile in which tillage takes place.
Plowpan. A compacted layer formed in the soil immediately below plow depth.
Profile (soil). A vertical section of the soil through all its horizons and extending into the parent material.
Range. Land that produces mainly native forage suitable for grazing by livestock.
Relief. Elevations or inequalities of the land surface, considered collectively.
Runoff. Surface drainage of rain or melted snow.
Sand. Individual rock or mineral fragments having diameters ranging from 0.05 millimeter to 2.0 millimeters. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.
Silt. Individual mineral particles of soil that range in diameter from the upper size of clay, 0.002 millimeter, to the lower size of very fine sand, 0.05 millimeter. Soil of the textural class called silt contains 80 percent or more of silt and less than 12 percent of clay.
Soil association. A group of soils, with or without characteristics in common, that occur in a regular geographical pattern.
Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soils includes the A and B horizons.
Structure (soil). The aggregation of primary soil particles into compound particles, or clusters of primary particles, which are separated from adjoining aggregates by planes of weakness.
Stubble mulch. A protective cover provided by leaving plant residue of any previous crops as a mulch on the soil surface when preparing for and planting the following crop.
Stubble mulching. A type of tillage used in areas subject to wind erosion. Tillage implements loosen the subsoil and eradicate weeds but leave the crop stubble more or less undisturbed.
Subsoil. Technically, the B horizon of soils with distinct layers, roughly, that part of the profile below plow depth.
Substratum. Any layer beneath the solum, or true soil; the C or R horizon.
Subsurface layer. The layer next to the surface layer. Normally a part of the A horizon.
Surface soil. The soil ordinaily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches thick.
Texture (soil). The relative properties of the various size groups of individual soil grains in a mass of soil; specifically, the proportions of sand, silt, and clay.
Tilth (soil). The condition of the soil in its relation to the growth of plants. A soil in poor tilth is nonfriable, hard, and difficult to till.
Water-holding capacity. The ability of a soil to hold water available for the use of plants.
Windbreak. A barrier of trees and shrubs, usually in three or more rows, that reduces the force of the wind.
Wind stripcropping. The production of crops in long, relatively narrow strips that extend crosswise to the direction of the prevailing wind and without regard to the contour of the land.

GUIDE TO MAPPING UNITS

[To obtain a full description of a mapping unit read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs.

[See table 1, page 7, for approximate acreage and proportionate extent of the soils; table 2, page 38, for predicted average acre yields of principal crops. Descriptions of range sites are on pages 41, 42, and 43, and descriptions of woodland suitability groups are on pages 43 and 44]

Map symbol	Mapping unit	Described on page	Capability unit		Range site	Woodland suitability group
			Symbol	Page	Name	Number
AbE	Albion soils, 5 to 12 percent slopes	8	VIe-2	36	Sandy Prairie	1
BeA	Bethany silt loam, 0 to 1 percent slopes	8	I-2	29	Loamy Prairie	2
Bk	Breaks-Alluvial land complex	8				
	Breaks part	--	VIe-3	36	Red Clay Prairie	2
	Alluvial land	--	VIe-3	36	Loamy Bottom Land	2
Br	Broken alluvial land	8	Vw-2	35	Loamy Bottom Land	2
Ca	Canadian fine sandy loam	8	I-1	29	Loamy Bottom Land	1
CsA	Carwile-Shellabarger complex, 0 to 2 percent slopes	9				
	Carwile soil	--	IIw-2	30	Loamy Prairie	1
	Shellabarger soil	--	IIw-2	30	Sandy Prairie	1
Cy	Clayey saline alluvial land	9	Vs-1	35	Alkali Bottom Land	4
Da	Dale silt loam	9	I-1	29	Loamy Bottom Land	1
DfA	Dill fine sandy loam, 0 to 1 percent slopes	10	IIe-2	30	Sandy Prairie	1
DfB	Dill fine sandy loam, 1 to 5 percent slopes	10	IIIe-2	32	Sandy Prairie	2
DfD	Dill fine sandy loam, 5 to 8 percent slopes	10	IVe-6	34	Sandy Prairie	3
DfD2	Dill fine sandy loam, 5 to 8 percent slopes, eroded	10	IVe-4	34	Sandy Prairie	3
Er	Eroded loamy land	10	VIe-5	36	Loamy Prairie	4
FaA	Farnum fine sandy loam, 0 to 3 percent slopes	11	IIe-2	30	Loamy Prairie	2
GrB	Grant silt loam, 1 to 3 percent slopes	11	IIe-1	30	Loamy Prairie	2
GrC	Grant silt loam, 3 to 5 percent slopes	11	IIIe-1	32	Loamy Prairie	2
GrD	Grant silt loam, 5 to 8 percent slopes	11	IVe-2	34	Loamy Prairie	3
GrD2	Grant silt loam, 4 to 8 percent slopes, eroded	11	IVe-4	34	Loamy Prairie	3
KfA	Kingfisher silt loam, 0 to 1 percent slopes	12	I-2	29	Loamy Prairie	2
KfB	Kingfisher silt loam, 1 to 3 percent slopes	12	IIe-3	30	Loamy Prairie	2
KgC	Kingfisher-Grant silt loams, 3 to 5 percent slopes	12	IIIe-1	32	Loamy Prairie	2
KhD2	Kingfisher-Lucien complex, 4 to 8 percent slopes, eroded	12				
	Kingfisher soil	--	IVe-4	34	Loamy Prairie	3
	Lucien soil (with rock outcrops)	--	IVe-4	34	Shallow Prairie	3
KlB	Kingfisher-Slickspots complex, 1 to 3 percent slopes	13				
	Kingfisher soil	--	IIIs-1	33	Loamy Prairie	3
	Slickspots	--	IIIs-1	33	Slickspot	3
KrA	Kirkland silt loam, 0 to 1 percent slopes	13	IIs-1	31	Claypan Prairie	3
KoB	Konawa loamy fine sand, undulating	14	IIIe-3	32	Deep Sand Savannah	2
KoC	Konawa loamy fine sand, hummocky	14	IVe-3	34	Deep Sand Savannah	2
Lc	Lela clay, wet	15	IVw-1	35	Subirrigated	4
Le	Lela, wet-Slickspots complex	15				
	Lela soil	--	IVw-2	35	Subirrigated	4
	Slickspots	--	IVw-2	35	Alkali Bottom Land	4

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability unit Symbol	Capability unit Page	Range site Name	Woodland suitability group Number
Lh	Leshara-Slickspots complex	15				
	Leshara soil	--	IVw-2	35	Loamy Bottom Land	3
	Slickspots	--	IVw-2	35	Alkali Bottom Land	3
Ln	Lincoln loamy fine sand	15	IIIe-6	33	Sandy Bottom Land	1
Lr	Lucien-Rock outcrop complex	16	VIIs-1	36	Breaks	4
Mc	McLain silty clay loam	16	I-1	29	Loamy Bottom Land	1
MlB	Miles fine sandy loam, 1 to 3 percent slopes	16	IIe-2	30	Sandy Prairie	1
MlC	Miles fine sandy loam, 3 to 5 percent slopes	17	IIIe-2	32	Sandy Prairie	2
MnA	Minco loam, 0 to 1 percent slopes	17	I-2	29	Loamy Prairie	1
MnB	Minco loam, 1 to 3 percent slopes	17	IIe-1	30	Loamy Prairie	1
MnC	Minco loam, 3 to 5 percent slopes	17	IIIe-1	32	Loamy Prairie	2
MoD	Minco very fine sandy loam, 3 to 8 percent slopes	17	IVe-2	34	Loamy Prairie	3
MoE	Minco very fine sandy loam, steep	17	VIe-5	36	Loamy Prairie	4
NcB	Nobscot fine sand, undulating	18	IVe-7	35	Deep Sand Savannah	2
NcC	Nobscot fine sand, hummocky	18	IVe-7	35	Deep Sand Savannah	2
NcD	Nobscot fine sand, rolling	18	VIe-4	36	Deep Sand Savannah	2
NoA	Norge loam, 0 to 1 percent slopes	18	I-2	29	Loamy Prairie	2
NoB	Norge loam, 1 to 3 percent slopes	19	IIe-3	30	Loamy Prairie	2
NoC	Norge loam, 3 to 5 percent slopes	19	IIIe-1	32	Loamy Prairie	2
NoD	Norge loam, 5 to 8 percent slopes	19	IVe-2	34	Loamy Prairie	3
NsA	Norge-Slickspots complex, 0 to 3 percent slopes	19				
	Norge soil	--	IIIs-1	33	Loamy Prairie	3
	Slickspots	--	IIIs-1	33	Slickspot	3
Pc	Port clay loam	20	IIw-3	31	Loamy Bottom Land	1
Po	Port loam	20	IIw-3	31	Loamy Bottom Land	1
PrB	Pratt loamy fine sand, undulating	20	IIIe-3	32	Deep Sand	2
PrC	Pratt loamy fine sand, hummocky	20	IVe-7	35	Deep Sand	3
QwF	Quinlan-Woodward loams, 5 to 20 percent slopes	21				
	Quinlan soil	--	VIe-6	36	Shallow Prairie	4
	Woodward soil	--	VIe-6	36	Loamy Prairie	4
Ra	Reinach very fine sandy loam	21	I-1	29	Loamy Bottom Land	1
RcA	Renfrow silty clay loam, 0 to 1 percent slopes	21	IIs-1	31	Claypan Prairie	3
RcB	Renfrow silty clay loam, 1 to 3 percent slopes	22	IIIe-4	32	Claypan Prairie	3
RnC2	Renfrow-Vernon complex, 3 to 5 percent slopes, eroded	22				
	Renfrow soil	--	IVe-5	34	Claypan Prairie	3
	Vernon soil	--	IVe-5	34	Red Clay Prairie	3
Ro	Rough broken land	22	VIIs-1	36	Breaks	4
Sb	Sandy broken land	22	VIe-1	36	Deep Sand Savannah-Breaks	4 1
ShA	Shellabarger fine sandy loam, 0 to 3 percent slopes	22	IIe-2	30	Sandy Prairie	1
ShC	Shellabarger fine sandy loam, 3 to 5 percent slopes	23	IIIe-2	32	Sandy Prairie	2
SpA	St. Paul silt loam, 0 to 1 percent slopes	24	IIc-1	29	Hard Land	2
SpB	St. Paul silt loam, 1 to 3 percent slopes	24	IIe-3	30	Hard Land	2
StD	Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes	23	IVe-6	34	Sandy Prairie	3

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability unit		Range site	Woodland suitability group
			Symbol	Page	Name	Number
StD2	Shellabarger-Teller fine sandy loams, 5 to 8 percent slopes, eroded	23	IVe-4	34	Sandy Prairie	3
Ta	Tabler silty clay loam	24	IIs-2	32	Claypan Prairie	3
TfA	Teller fine sandy loam, 1 to 3 percent slopes	25	IIe-2	30	Sandy Prairie	1
TfC	Teller fine sandy loam, 3 to 5 percent slopes	25	IIIe-2	32	Sandy Prairie	1
TrD	Tivoli fine sand, rolling	25	VIIe-1	36	Dune	4
VaA	Vanoss loam, 0 to 1 percent slopes	26	I-2	29	Loamy Prairie	1
VaB	Vanoss loam, 1 to 3 percent slopes	26	IIe-1	30	Loamy Prairie	2
VeB	Vernon clay loam, 1 to 3 percent slopes	26	IIIe-5	33	Red Clay Prairie	3
VeC	Vernon clay loam, 3 to 5 percent slopes	26	IVe-1	33	Red Clay Prairie	3
Vr	Vernon soils and Rock outcrop	26	VIIs-2	36	Red Clay Prairie	4
Wa	Wann soils	27	IIw-1	30	Loamy Bottom Land	2
Wt	Wet alluvial land	27	Vw-1	35	Subirrigated	4
Ya	Yahola loam	28	IIw-3	31	Loamy Bottom Land	1

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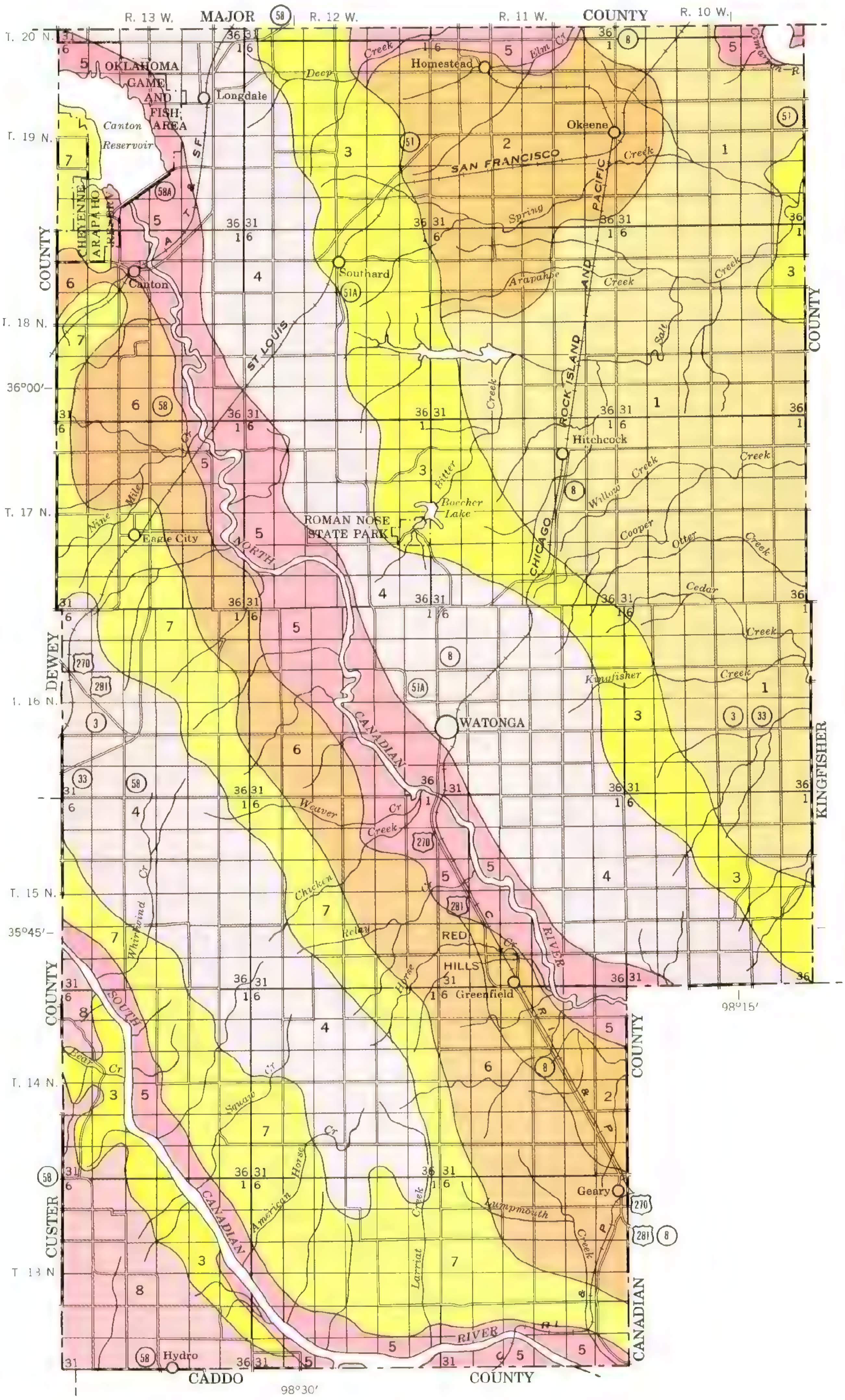
program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).



GENERAL SOIL MAP

BLAINE COUNTY, OKLAHOMA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

N

SCALE IN MILES
1 0 1 2 3 4

SOIL ASSOCIATIONS

1

Norge-Kingfisher-Renfrow association: Deep, loamy, well-drained, nearly level to sloping soils of the uplands; loamy and clayey subsoil

2

Bethany-Kirkland-Tabler association: Deep, well-drained and moderately well drained, nearly level soils of the uplands; clayey subsoil

3

Vernon-Lucien association: Shallow, very gently sloping to moderately steep soils of the uplands

4

Shellabarger-Nobscot-Pratt association: Deep, loamy to sandy, nearly level to strongly sloping soils of the uplands

5

Canadian-Port-Lincoln association: Deep, well-drained, loamy and sandy, nearly level soils of flood plains

6

Grant-St. Paul association: Deep, loamy, well-drained, nearly level to sloping soils of the uplands

7

Dill-Minco-Nobscot association: Moderately deep to deep, loamy and sandy soils of very gently sloping to steep uplands

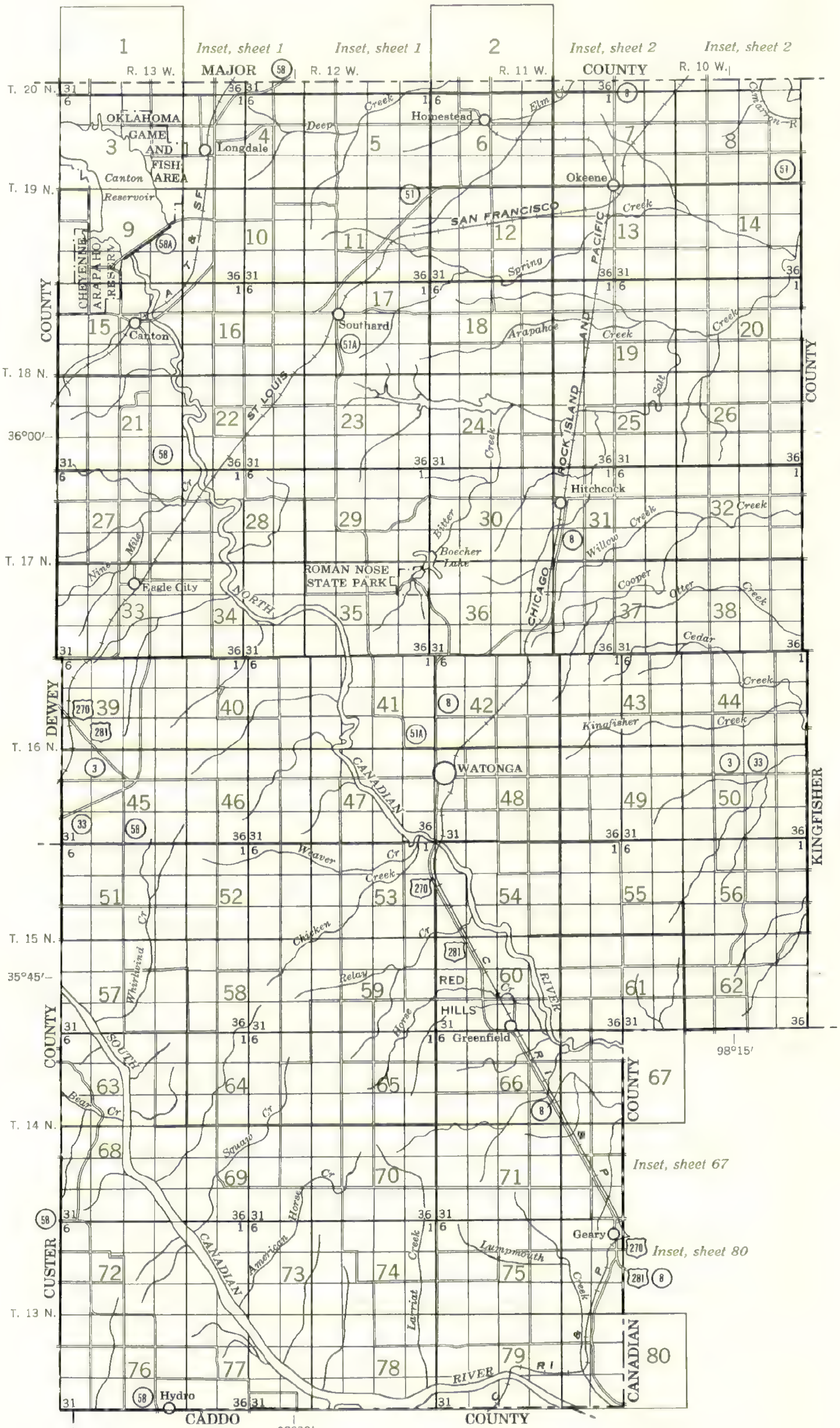
8

Vanoss-Minco association: Deep, loamy soils of nearly level to gently sloping high terraces

May 1967

INDEX TO MAP SHEETS

BLAINE COUNTY, OKLAHOMA



SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F shows the slope. Most symbols without a slope letter are those of soils or land types that are nearly level, but some are for soils or land types that have a considerable range of slope. A final number, 2, in the symbol shows that the soil is eroded.

SYMBOL	NAME
AbE	Albion soils, 5 to 12 percent slopes
BeA	Bethany silt loam, 0 to 1 percent slopes
Bk	Breaks—Alluvial land complex
Br	Broken alluvial land
Ca	Canadian fine sandy loam
CsA	Carwile—Shellabarger complex, 0 to 2 percent slopes
Cy	Clayey saline alluvial land
Da	Dale silt loam
DfA	Dill fine sandy loam, 0 to 1 percent slopes
DfB	Dill fine sandy loam, 1 to 5 percent slopes
DfD	Dill fine sandy loam, 5 to 8 percent slopes
DfD2	Dill fine sandy loam, 5 to 8 percent slopes, eroded
Er	Eroded loamy land
FaA	Farnum fine sandy loam, 0 to 3 percent slopes
GrB	Grant silt loam, 1 to 3 percent slopes
GrC	Grant silt loam, 3 to 5 percent slopes
GrD	Grant silt loam, 5 to 8 percent slopes
GrD2	Grant silt loam, 4 to 8 percent slopes, eroded
KfA	Kingfisher silt loam, 0 to 1 percent slopes
KfB	Kingfisher silt loam, 1 to 3 percent slopes
KgC	Kingfisher—Grant silt loams, 3 to 5 percent slopes
KhD2	Kingfisher—Lucien complex, 4 to 8 percent slopes, eroded
KlB	Kingfisher—Slickspots complex, 1 to 3 percent slopes
KoB	Konawa loamy fine sand, undulating
KoC	Konawa loamy fine sand, hummocky
KrA	Kirkland silt loam, 0 to 1 percent slopes
Lc	Lela clay, wet
Le	Lela, wet—Slickspots complex
Lh	Leshara—Slickspots complex
Ln	Lincoln loamy fine sand
Lr	Lucien—Rock outcrop complex
Mc	McLain silty clay loam
MlB	Miles fine sandy loam, 1 to 3 percent slopes
MlC	Miles fine sandy loam, 3 to 5 percent slopes
MnA	Minco loam, 0 to 1 percent slopes
MnB	Minco loam, 1 to 3 percent slopes
MnC	Minco loam, 3 to 5 percent slopes
MoD	Minco very fine sandy loam, 3 to 8 percent slopes
MoE	Minco very fine sandy loam, steep
NcB	Nobscot fine sand, undulating
NcC	Nobscot fine sand, hummocky
NcD	Nobscot fine sand, rolling
NoA	Norge loam, 0 to 1 percent slopes
NoB	Norge loam, 1 to 3 percent slopes
NoC	Norge loam, 3 to 5 percent slopes
NoD	Norge loam, 5 to 8 percent slopes
NsA	Norge—Slickspots complex, 0 to 3 percent slopes
Pc	Port clay loam
Po	Port loam
PrB	Pratt loamy fine sand, undulating
PrC	Pratt loamy fine sand, hummocky
QwF	Quinlan—Woodward loams, 5 to 20 percent slopes
Ra	Reinach very fine sandy loam
RcA	Renfrow silty clay loam, 0 to 1 percent slopes
RcB	Renfrow silty clay loam, 1 to 3 percent slopes
RnC2	Renfrow—Vernon complex, 3 to 5 percent slopes, eroded
Ro	Rough broken land

SYMBOL	NAME
Sb	Sandy broken land
ShA	Shellabarger fine sandy loam, 0 to 3 percent slopes
ShC	Shellabarger fine sandy loam, 3 to 5 percent slopes
SpA	St. Paul silt loam, 0 to 1 percent slopes
SpB	St. Paul silt loam, 1 to 3 percent slopes
StD	Shellabarger—Teller fine sandy loams, 5 to 8 percent slopes
StD2	Shellabarger—Teller fine sandy loams, 5 to 8 percent slopes, eroded
Ta	Tabler silty clay loam
TfA	Teller fine sandy loam, 1 to 3 percent slopes
TfC	Teller fine sandy loam, 3 to 5 percent slopes
TrD	Tivoli fine sand, rolling
VaA	Vanoss loam, 0 to 1 percent slopes
VaB	Vanoss loam, 1 to 3 percent slopes
VeB	Vernon clay loam, 1 to 3 percent slopes
VeC	Vernon clay loam, 3 to 5 percent slopes
Vr	Vernon soils and Rock outcrop
Wa	Wann soils
Wt	Wet alluvial land
Ya	Yahola loam

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferry — FY
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries

Mine dump

Pits, gravel or other

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

BOUNDARIES

- National or state
- County
- Township or range, U. S.
- Section line, corner, U. S.
- Reservation
- Land grant
- Small park, cemetery, airport

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
- Unclassified

Canals and ditches — CANAL

Lakes and ponds
- Perennial — water, w
- Intermittent

Wells, water — flowing

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peak

Depressions — Large, Small
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

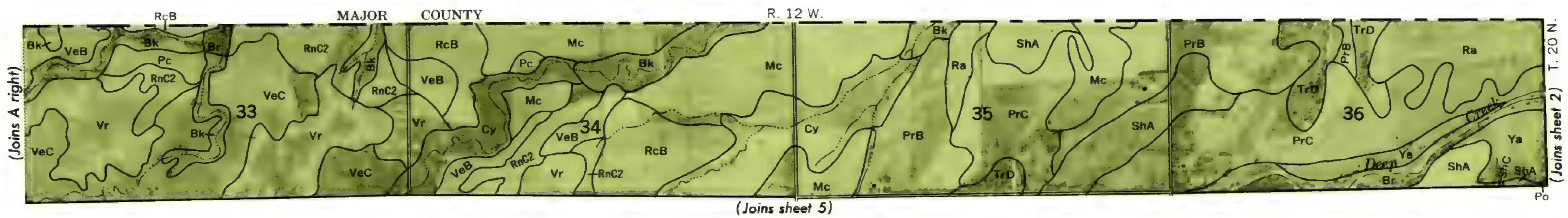
- Soil boundary and symbol — Dx
- Gravel
- Stony, very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Slickspot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

Soil map constructed 1966 by Cartographic Division, Soil Conservation Service, USDA, from 1964 aerial photographs. Controlled mosaic based on Oklahoma plane coordinate system, north zone, Lambert conformal conic projection, 1927 North American datum.

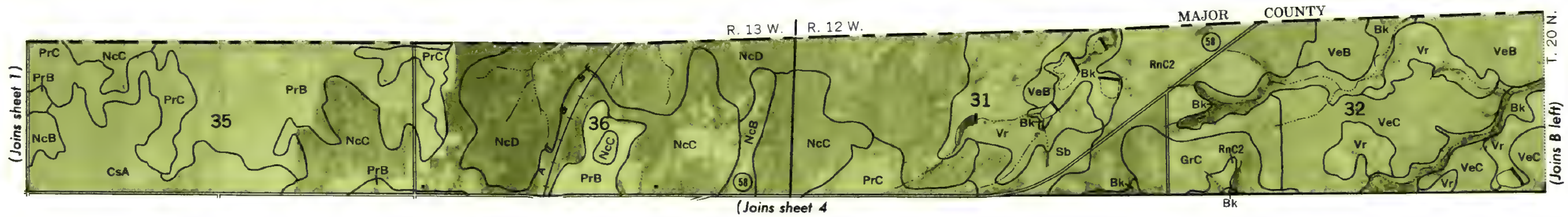
1

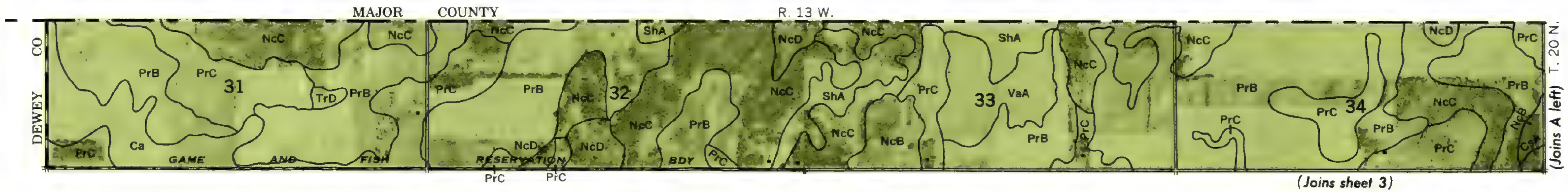
N

INSET B



INSET A





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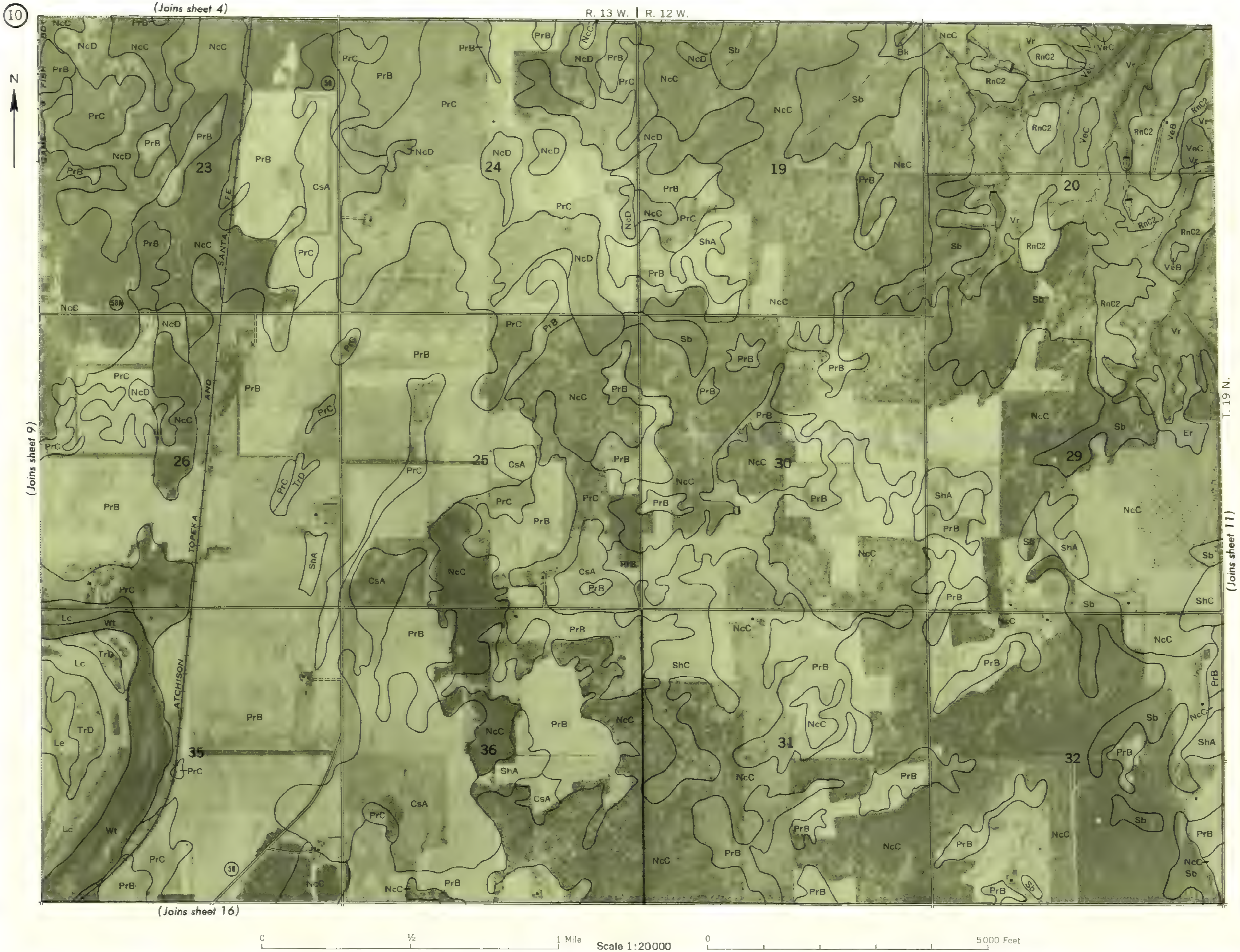
This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

BLAINE COUNTY, OKLAHOMA NO. 1


10
(Joins sheet 4)
R. 13 W. | R. 12 W.
N
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 16)
T. 19 N.
ATCHISON TOPEKA AND SANTA FE
23
24
19
20
26
25
30
29
35
36
31
32
0 ½ 1 Mile
Scale 1:20000
0 5000 Feet

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BLAINE COUNTY, OKLAHOMA NO. 11

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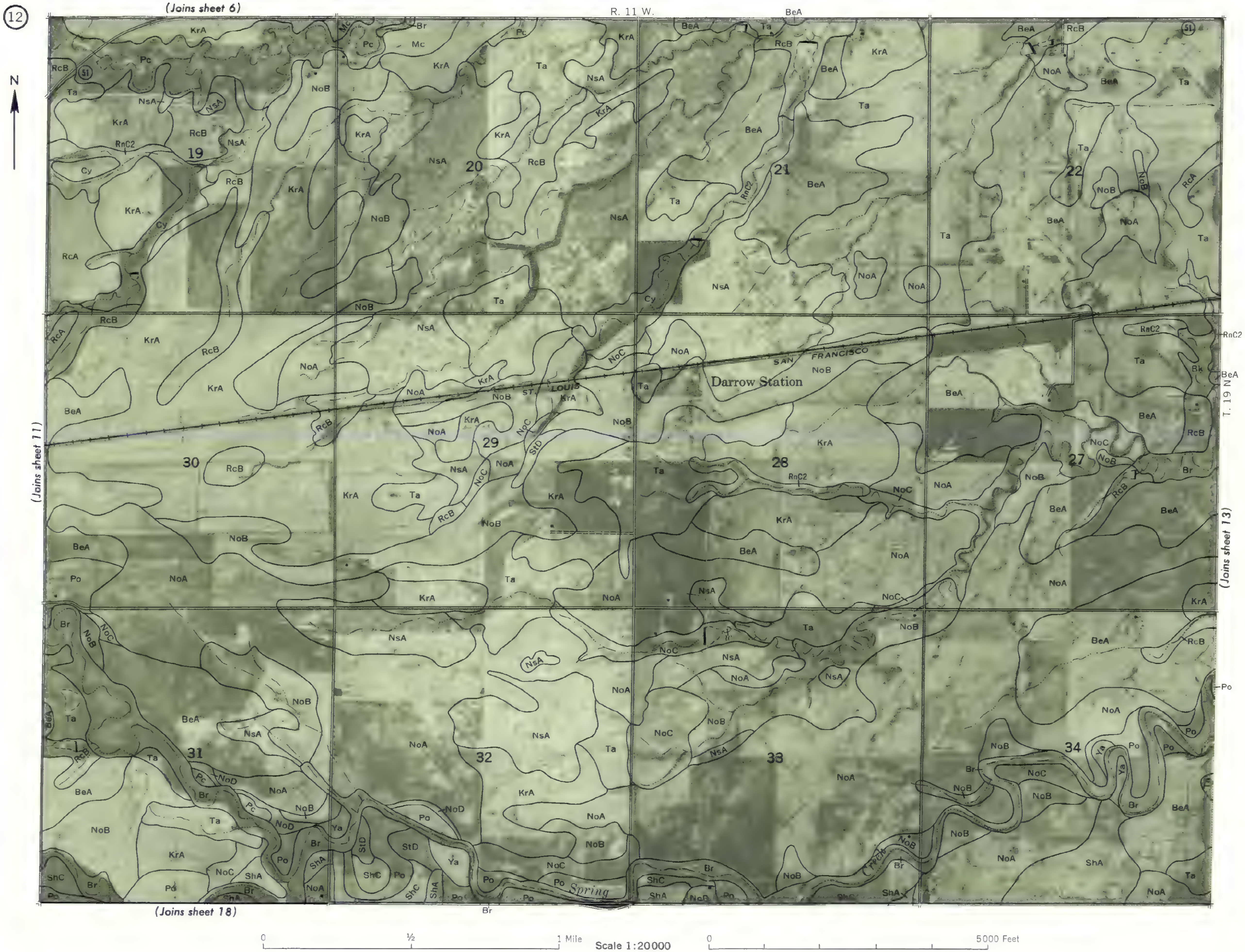
12
(Joins sheet 6)
R. 11 W.
N
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 18)
T. 19 N.
Darrow Station
ST. LOUIS
SAN FRANCISCO
Spring
Creek
19
20
21
22
27
28
29
30
31
32
33
34
0
½
1 Mile
Scale 1:20000
0
5000 Feet

BLAINE COUNTY, OKLAHOMA — SHEET NUMBER 13

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

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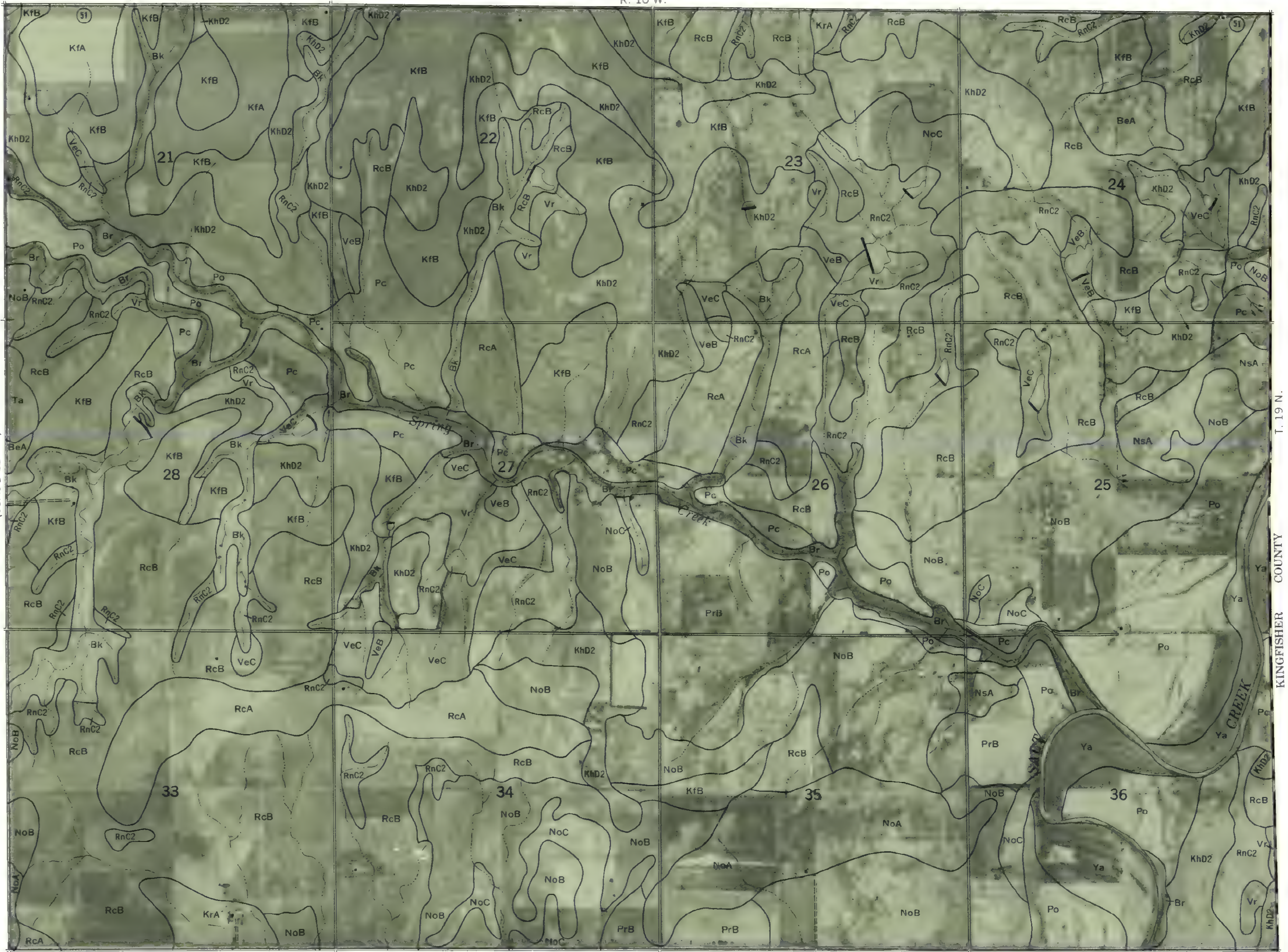
BLAINE COUNTY, OKLAHOMA NO. 13

(14) (Joins sheet 8)

R. 10 W.



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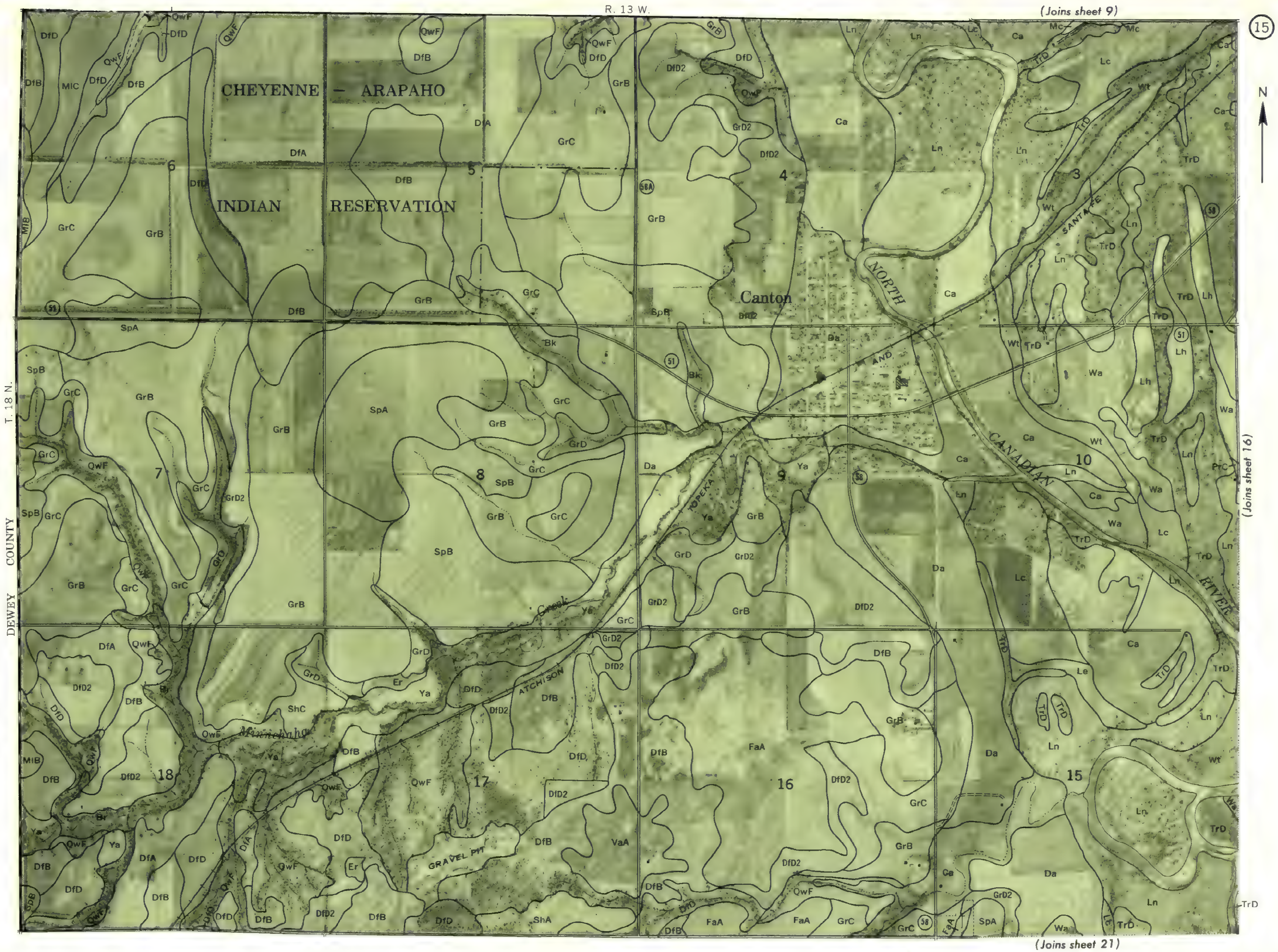
0 ½ 1 Mile Scale 1:20000 0 5000 Feet

BLAINE COUNTY, OKLAHOMA — SHEET NUMBER 15



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BLAINE COUNTY, OKLAHOMA NO. 15

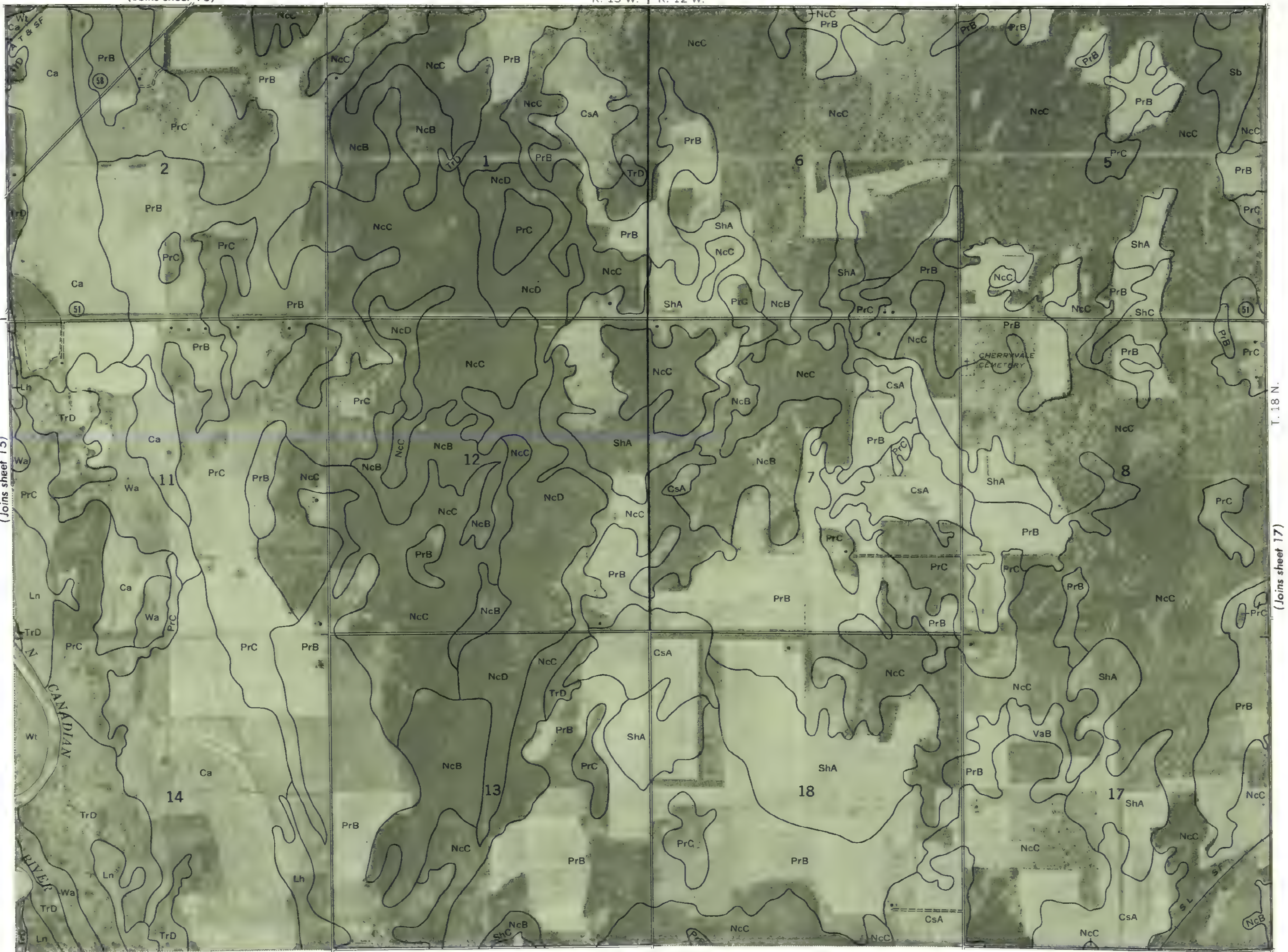
16

(Joins sheet 10)

R. 13 W. | R. 12 W.

N

(Joins sheet 15)



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(Joins sheet 22)

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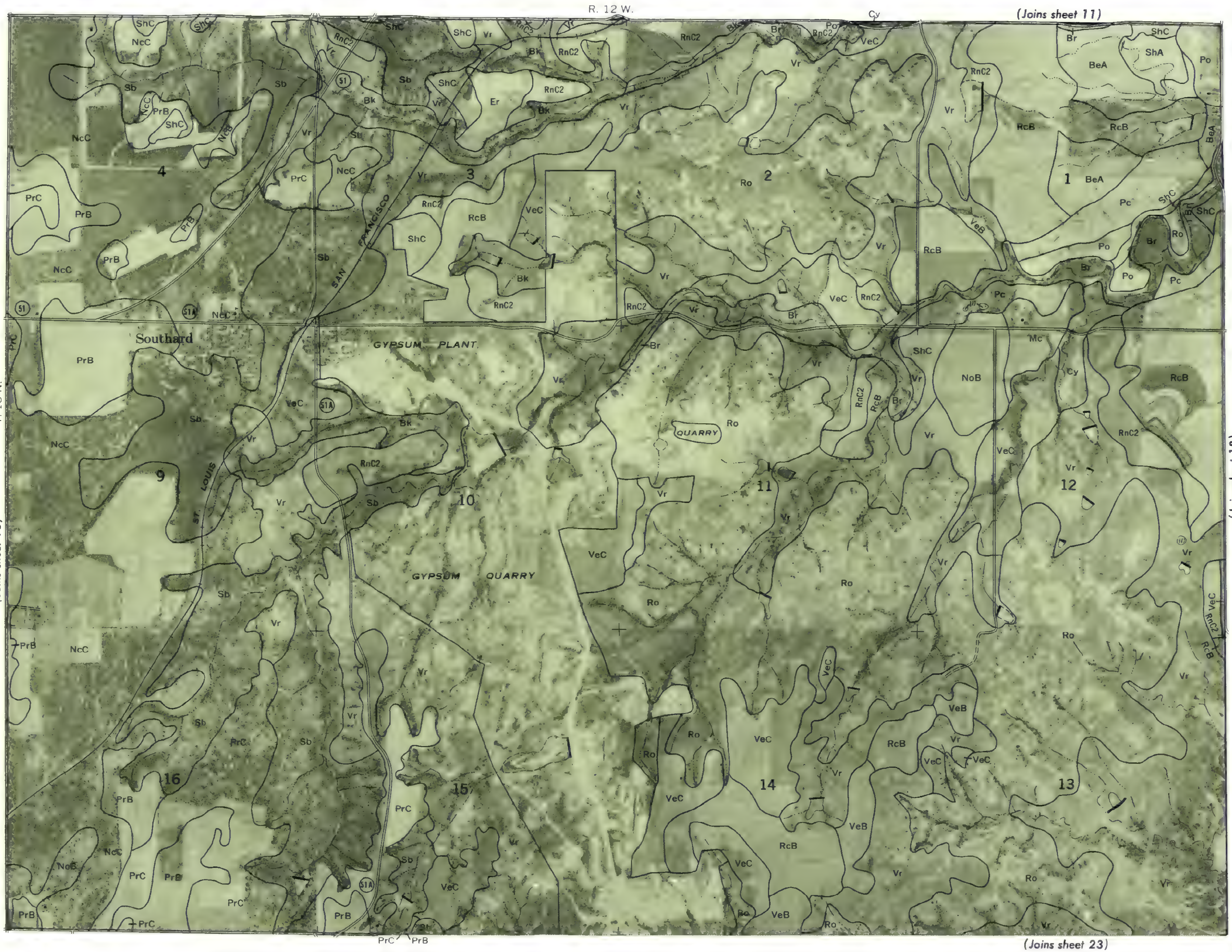

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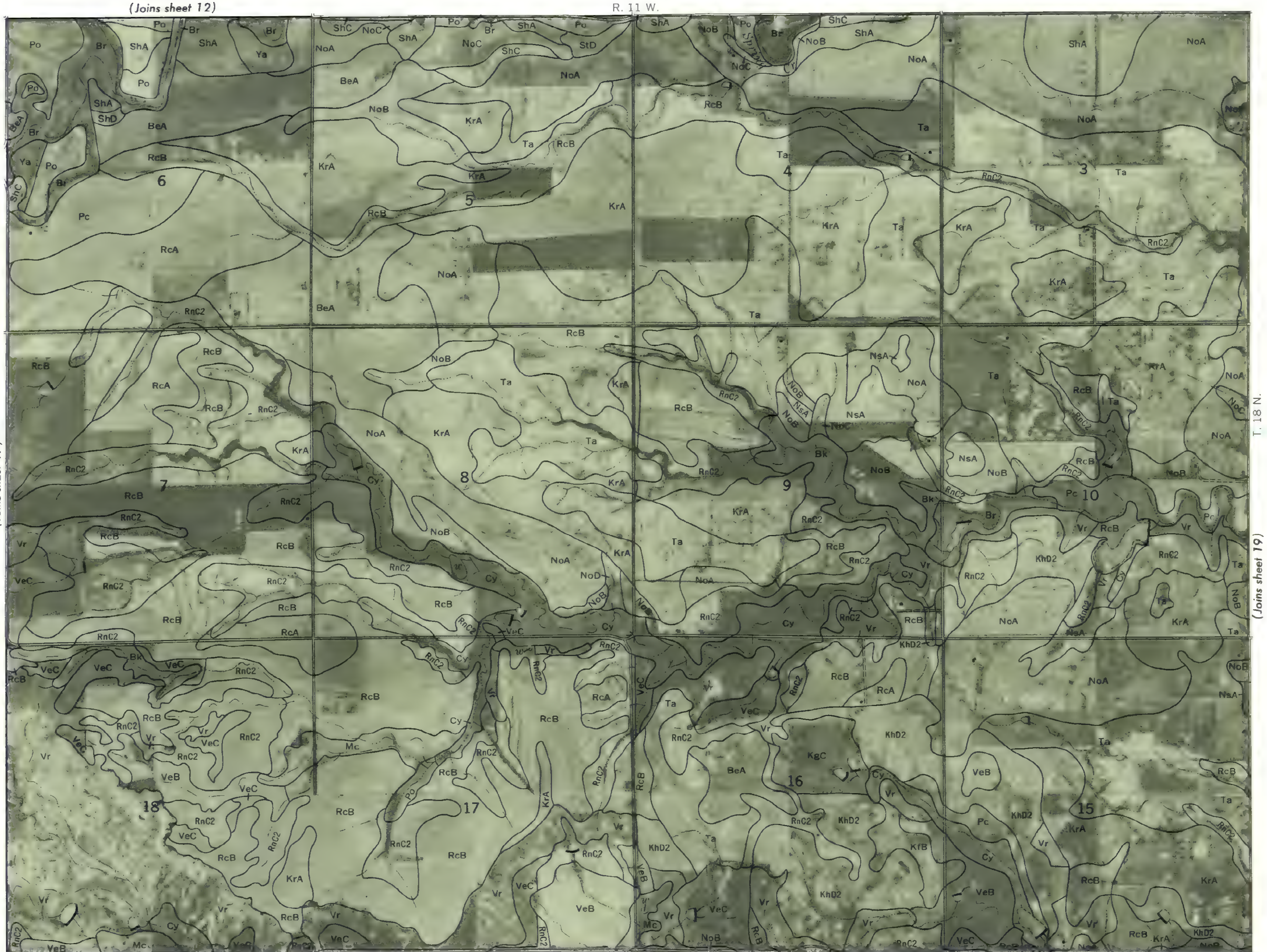
BLAINE COUNTY, OKLAHOMA NO. 17

18



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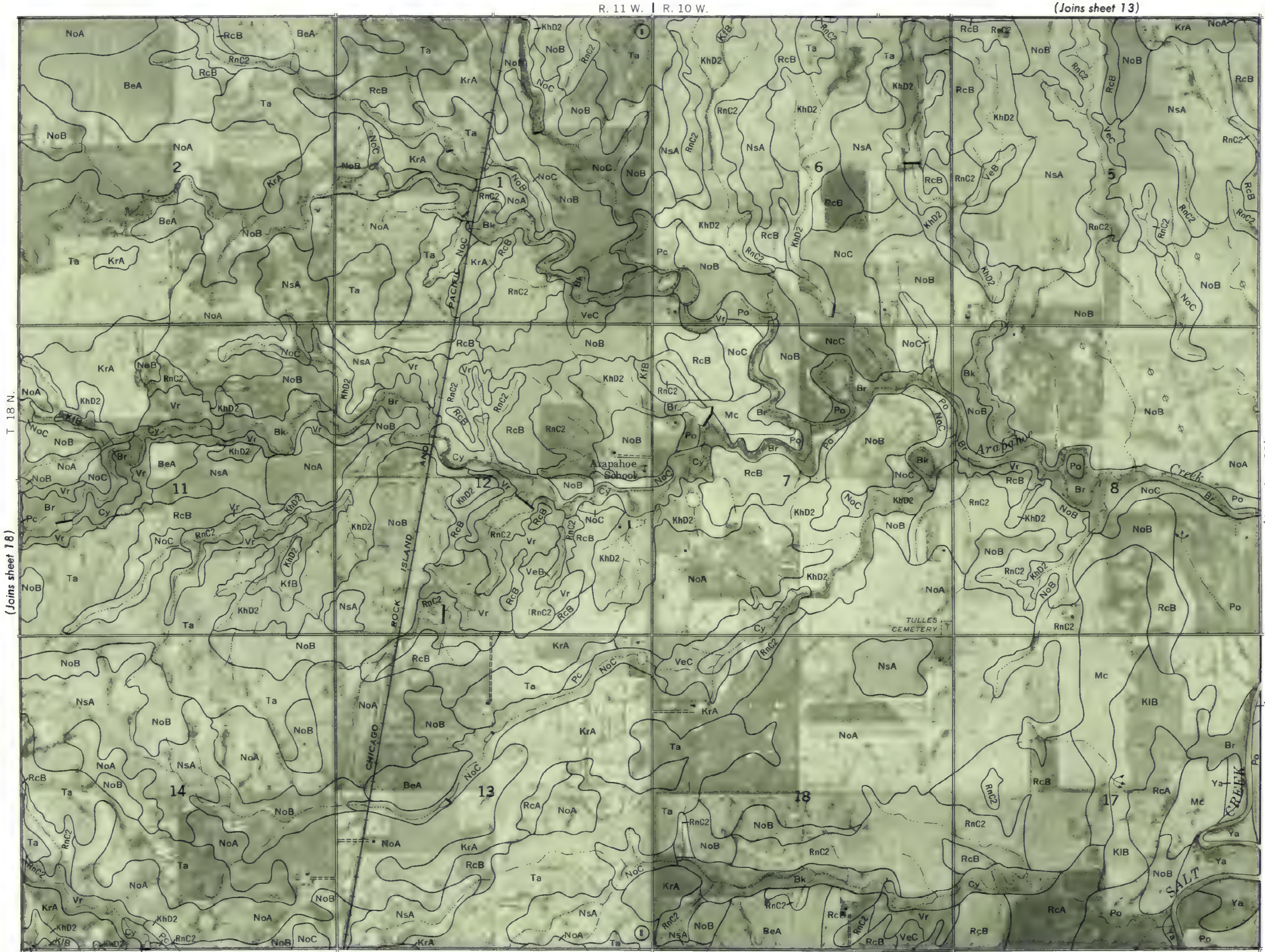
R. 11 W. | R. 10 W.

(Joins sheet 13)

(19)



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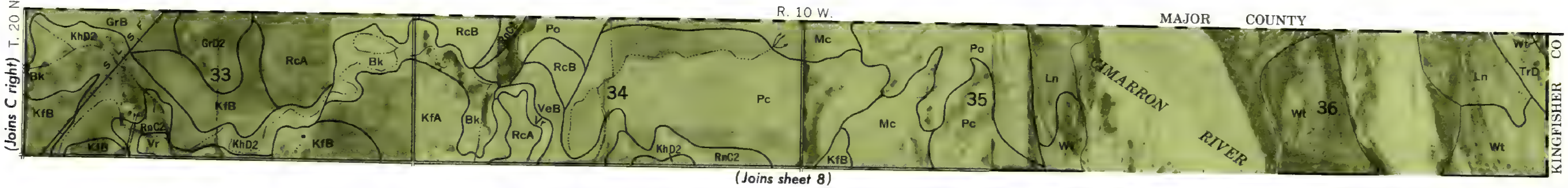
BLAINE COUNTY, OKLAHOMA NO. 19

BLAINE COUNTY, OKLAHOMA — SHEET NUMBER 2

2

N

INSET D



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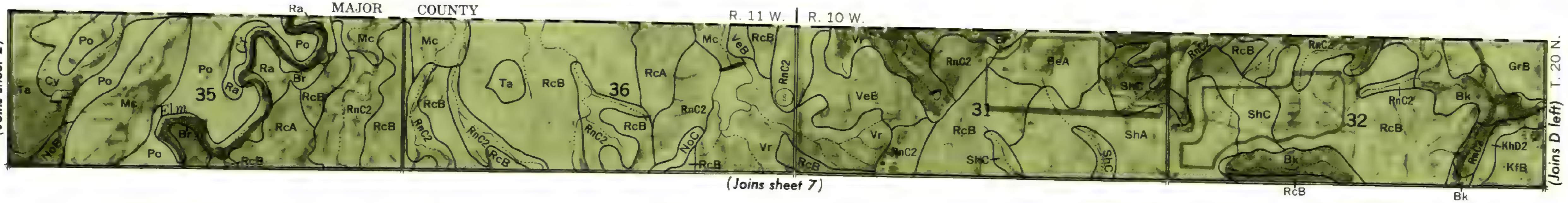
INSET C



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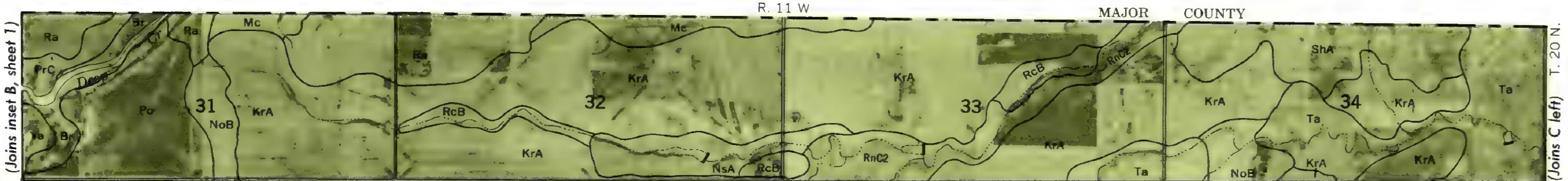

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0 ½ 1 Mile Scale 1:20000 0 5000 Feet

BLAINE COUNTY, OKLAHOMA NO. 2

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

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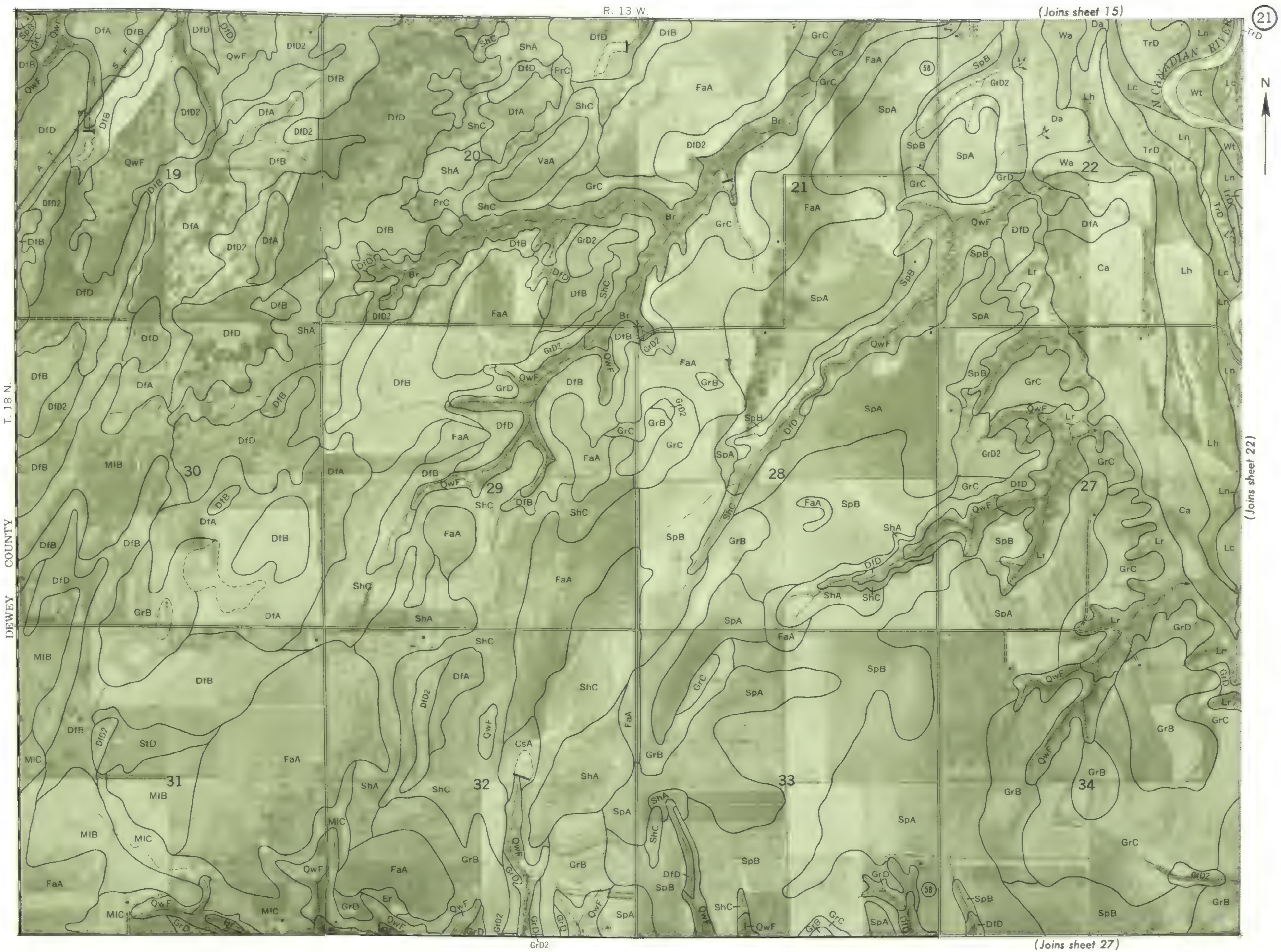
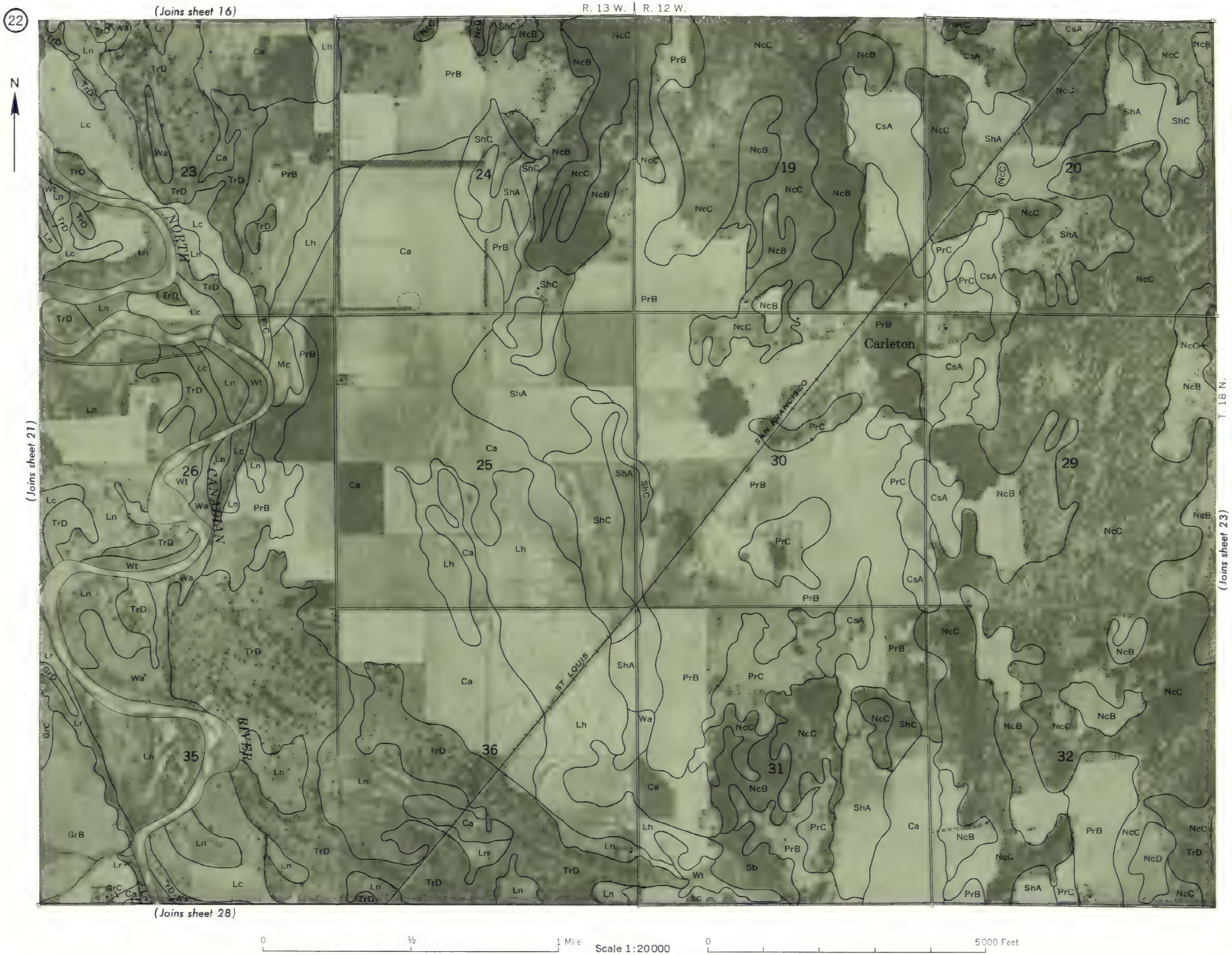
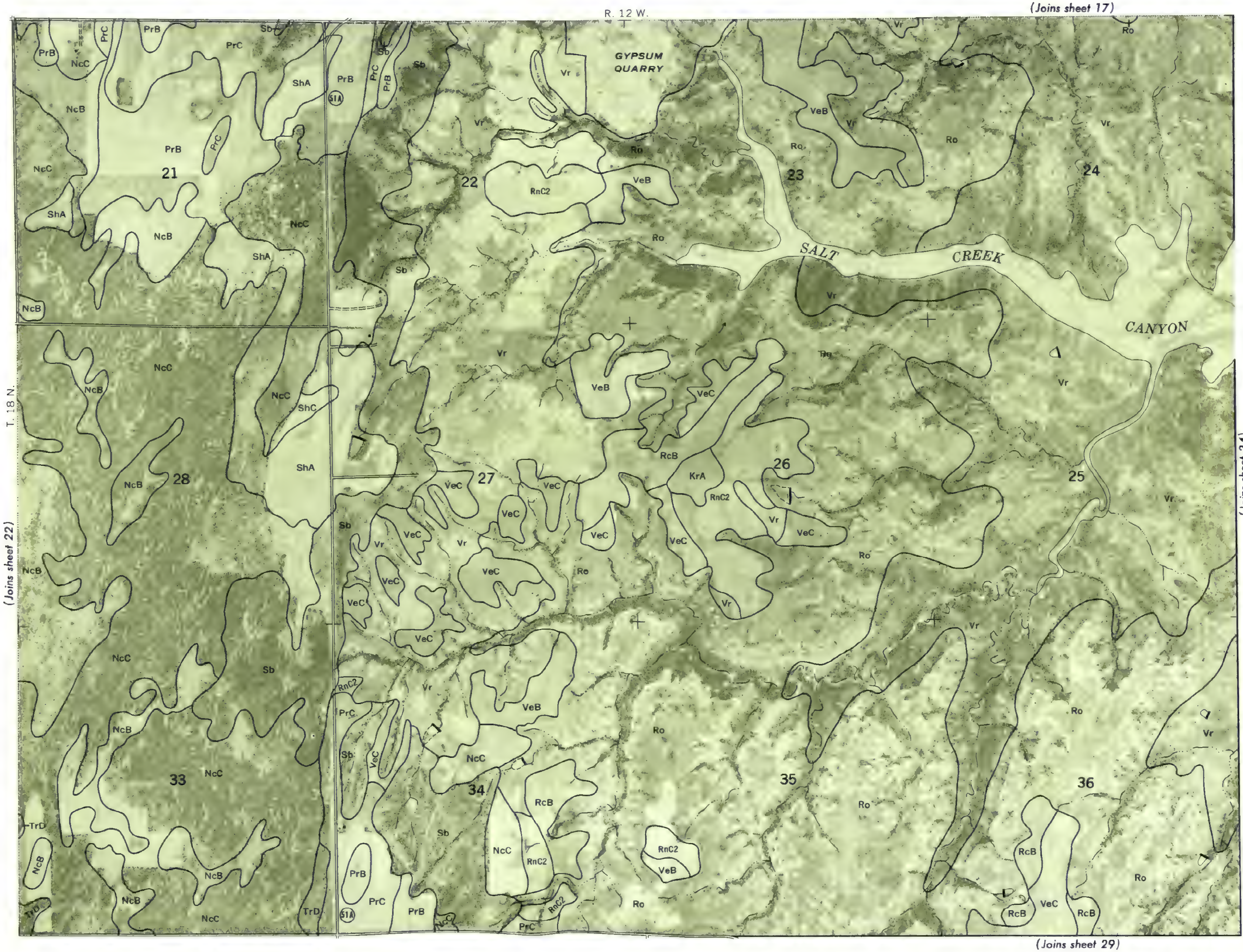
BLAINE COUNTY, OKLAHOMA NO. 21



0 ½ 1 Mile Scale 1:20000 0 5000 Feet


22
(Joins sheet 16)
R. 13 W. | R. 12 W.
N
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 28)
T. 18 N.
NORTH CANADIAN RIVER
Carleton
SAN FRANCISCO
ST LOUIS
19
20
23
24
25
26
29
30
31
32
35
36
0 ½ 1 Mile
Scale 1:20000
0 5000 Feet



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

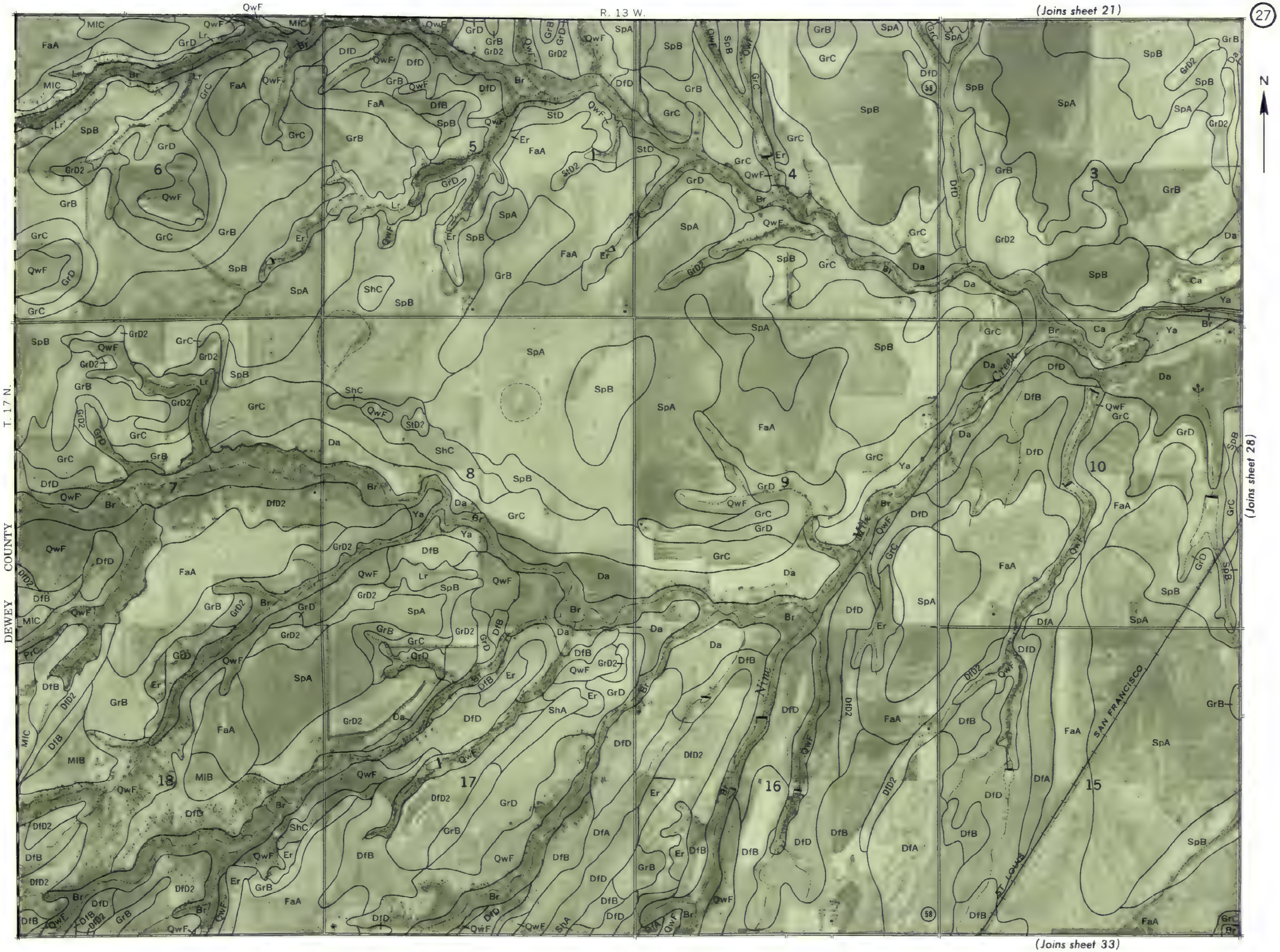

24
N
(Joins sheet 18)
R. 11 W.
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 30)
T. 18 N.
SALT
CANYON
CREEK
SALT
CREEK
Bitter
Creek
19
20
21
22
27
28
29
30
31
32
33
34
0
½
1 Mile
Scale 1:20000
0
5000 Feet

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station
Range, township, and section corners shown on this map are indefinite.

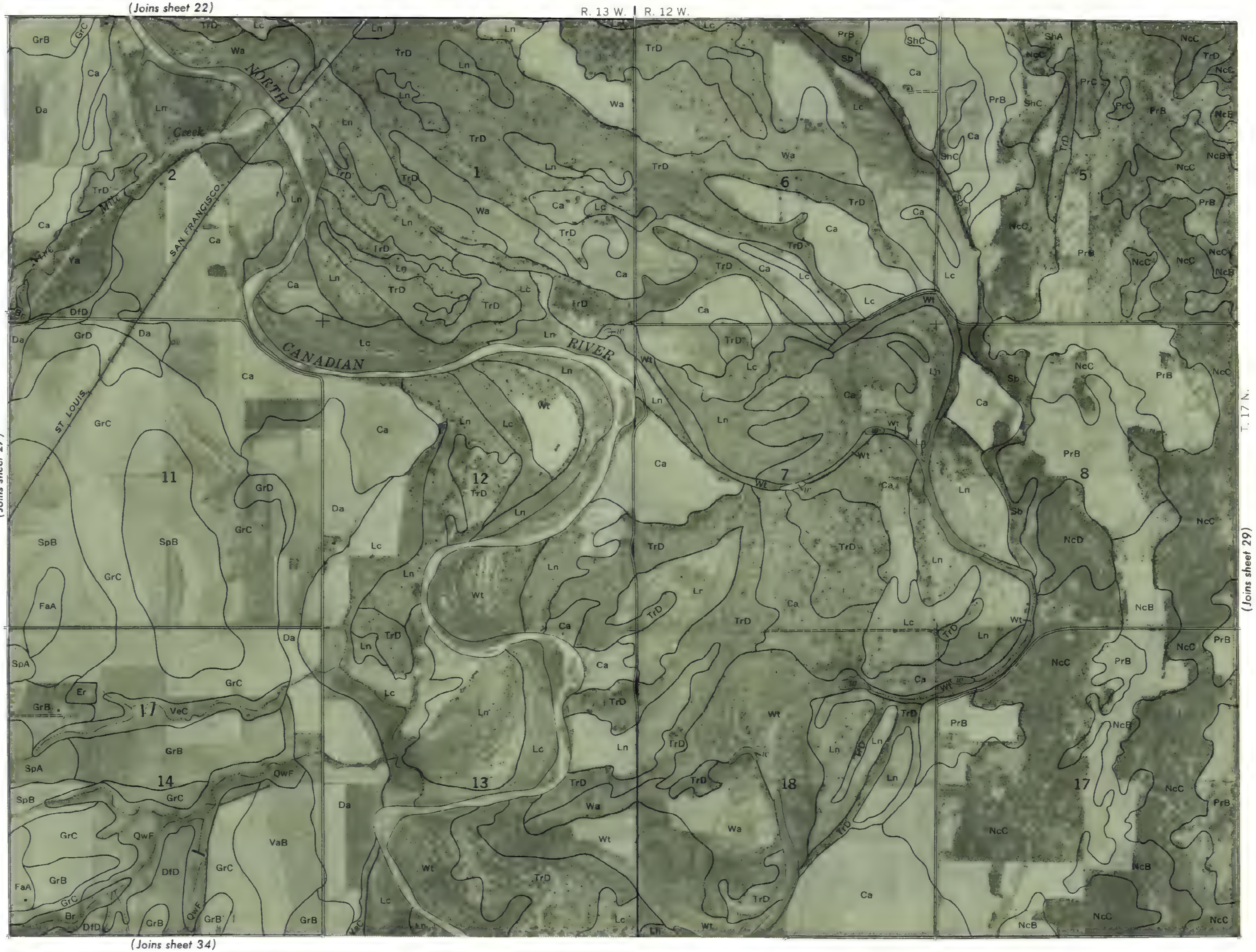
BLAINE COUNTY, OKLAHOMA — SHEET NUMBER 26

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.
BLAINE COUNTY, OKLAHOMA NO. 27



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

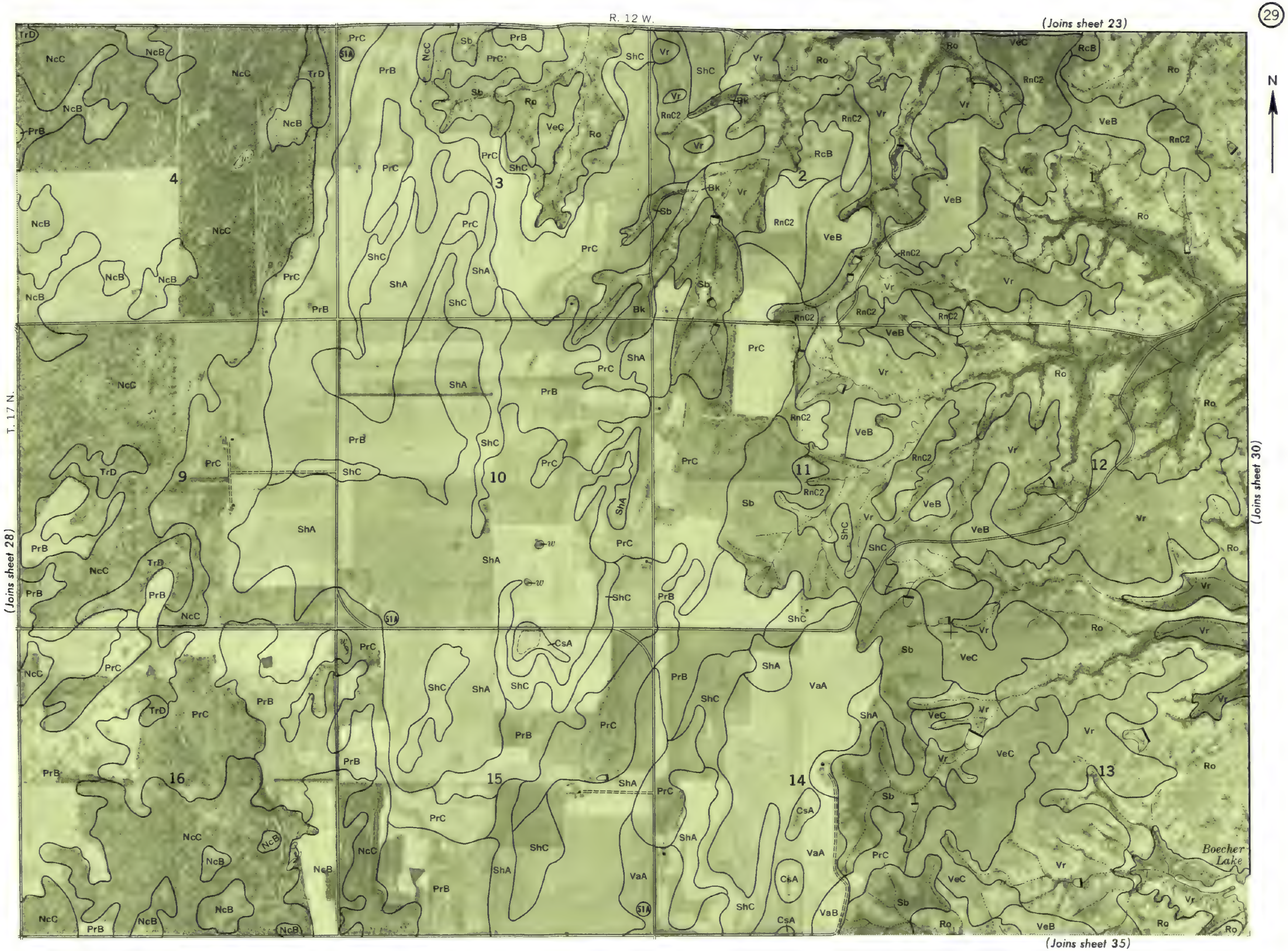
28



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station
Range, township, and section corners shown on this map are indefinite.

BLAINE COUNTY, OKLAHOMA NO. 29



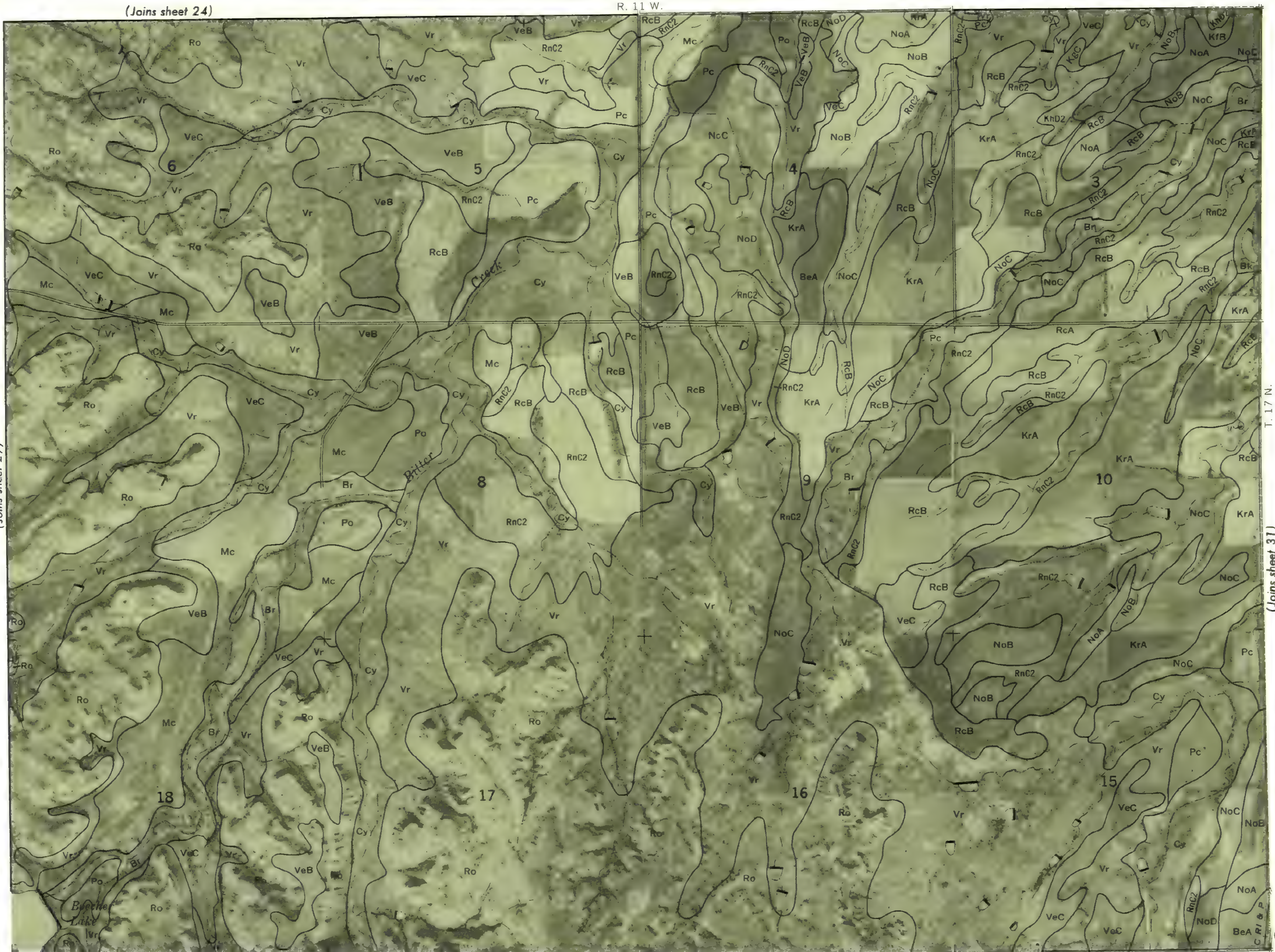
0 ½ 1 Mile Scale 1:20000 0 5000 Feet

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

30

(Joins sheet 24)

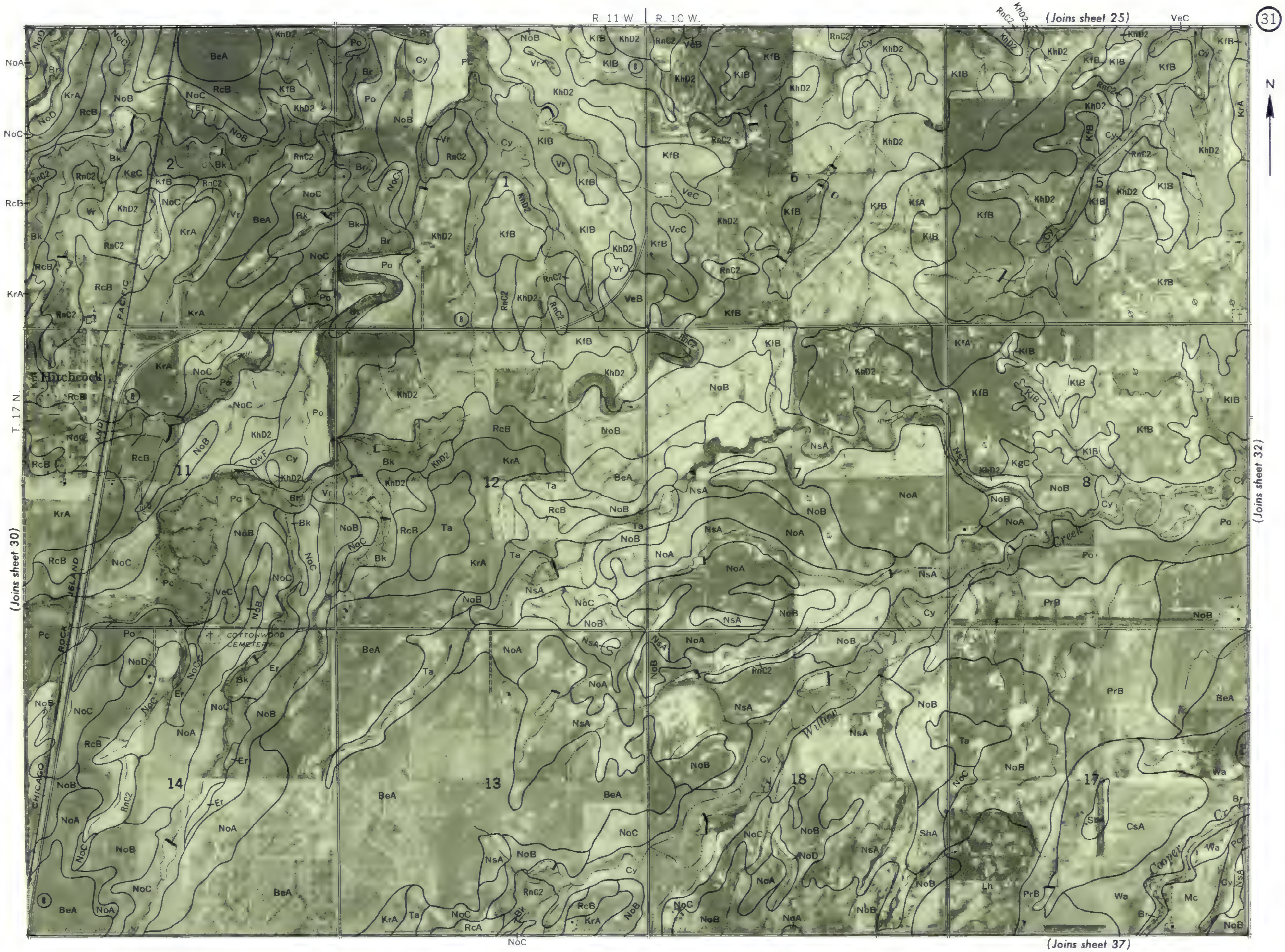


(Joins sheet 29)

(Joins sheet 31)

(Joins sheet 36)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

BLAINE COUNTY, OKLAHOMA NO. 31

32

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

Range, township, and section corners shown on this map are indefinite.


34
(Joins sheet 28)
R. 13 W.
R. 12 W.
N
(Joins sheet 33)
(Joins sheet 35)
T. 17 N.
(Sh 39)
(Joins sheet 40)
23
24
19
20
26
25
30
29
35
36
31
32
NORTH
CANADIAN
RIVER
0
½
1 Mile
Scale 1:20000
0
5000 Feet

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

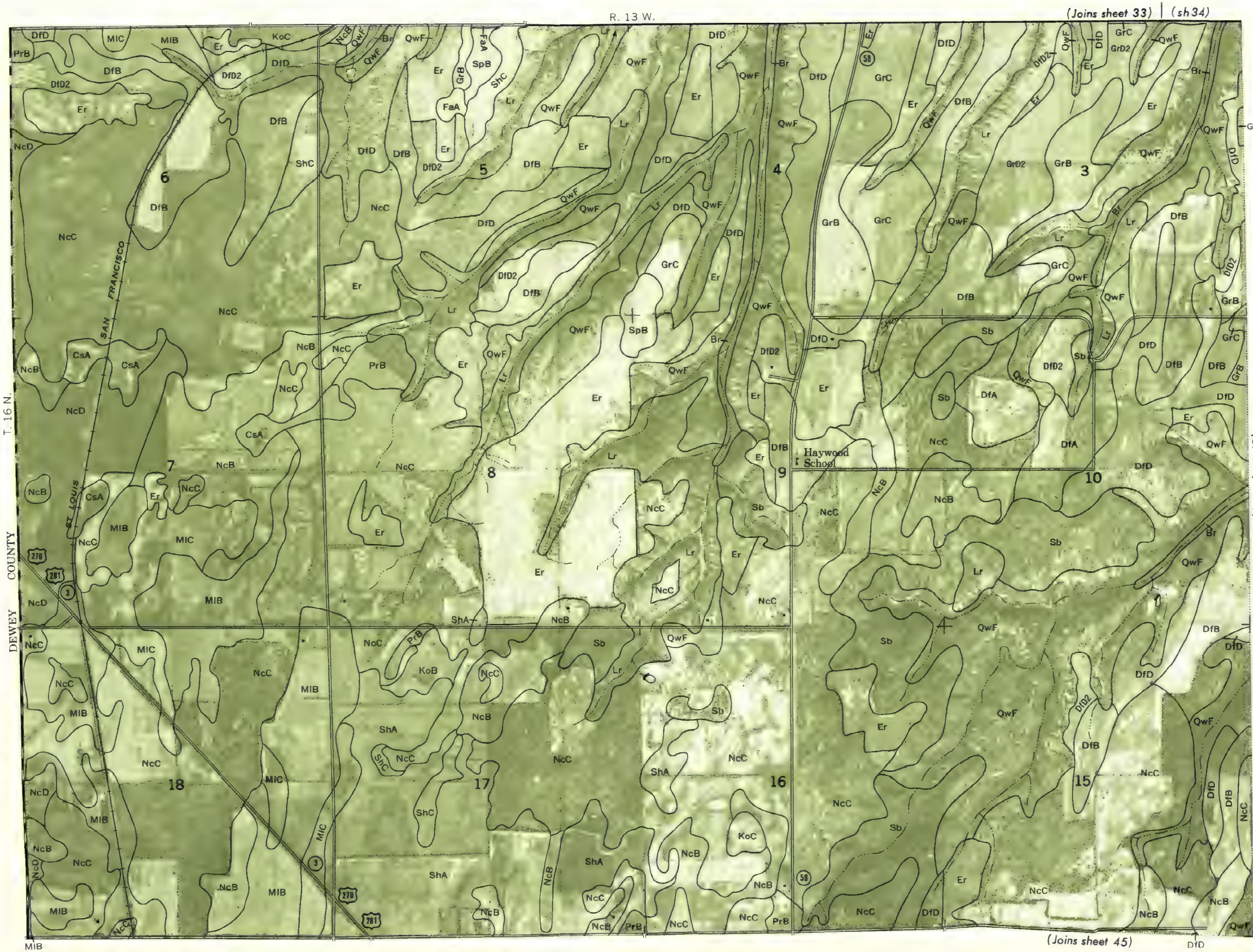
BLAINE COUNTY, OKLAHOMA NO. 35


36
(Joins sheet 30)
R. 11 W.
N
STATE PARK BOUNDARY
(Joins sheet 35)
(Joins sheet 37)
T. 17 N.
19
20
21
22
27
28
29
30
31
32
33
34
GYPSUM QUARRY
Bucher Station
CHICAGO ROCK ISLAND AND PACIFIC
(Sh 41) | (Joins sheet 42)
0 ½ 1 Mile
Scale 1:20000
0 5000 Feet

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

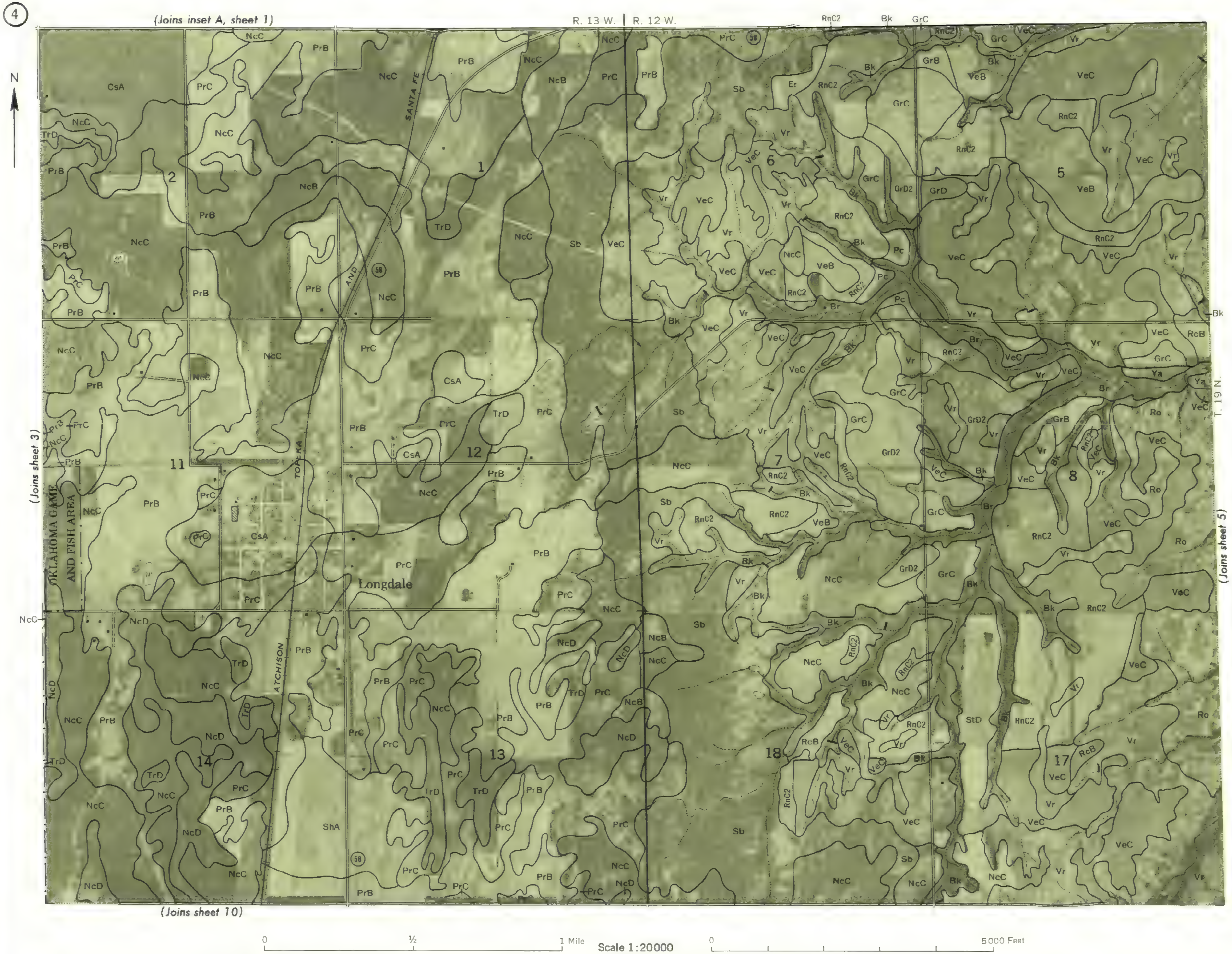
0 ½ 1 Mile Scale 1:20000 0 5000 Feet

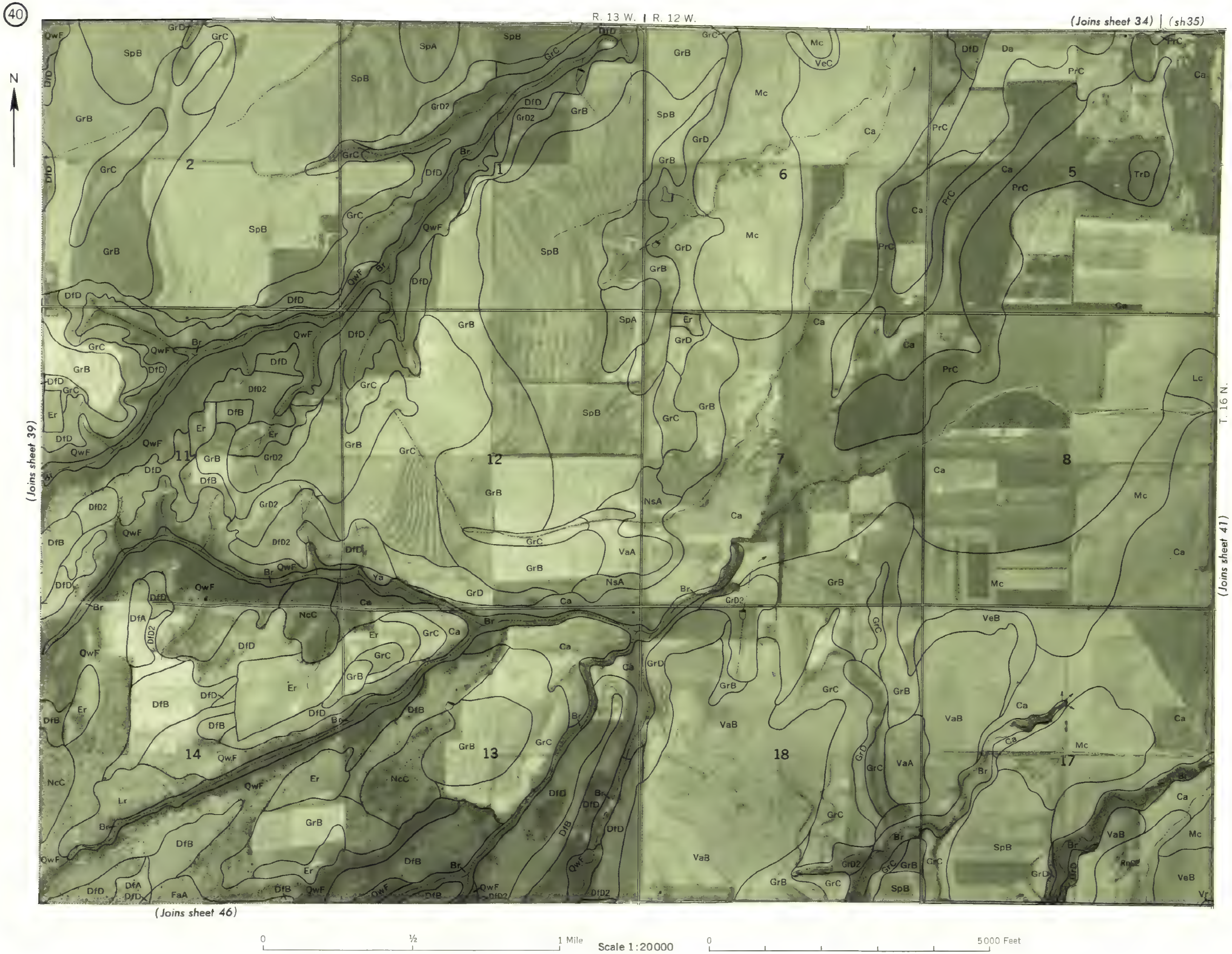


0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station. Range, township, and section corners shown on this map are indefinite.

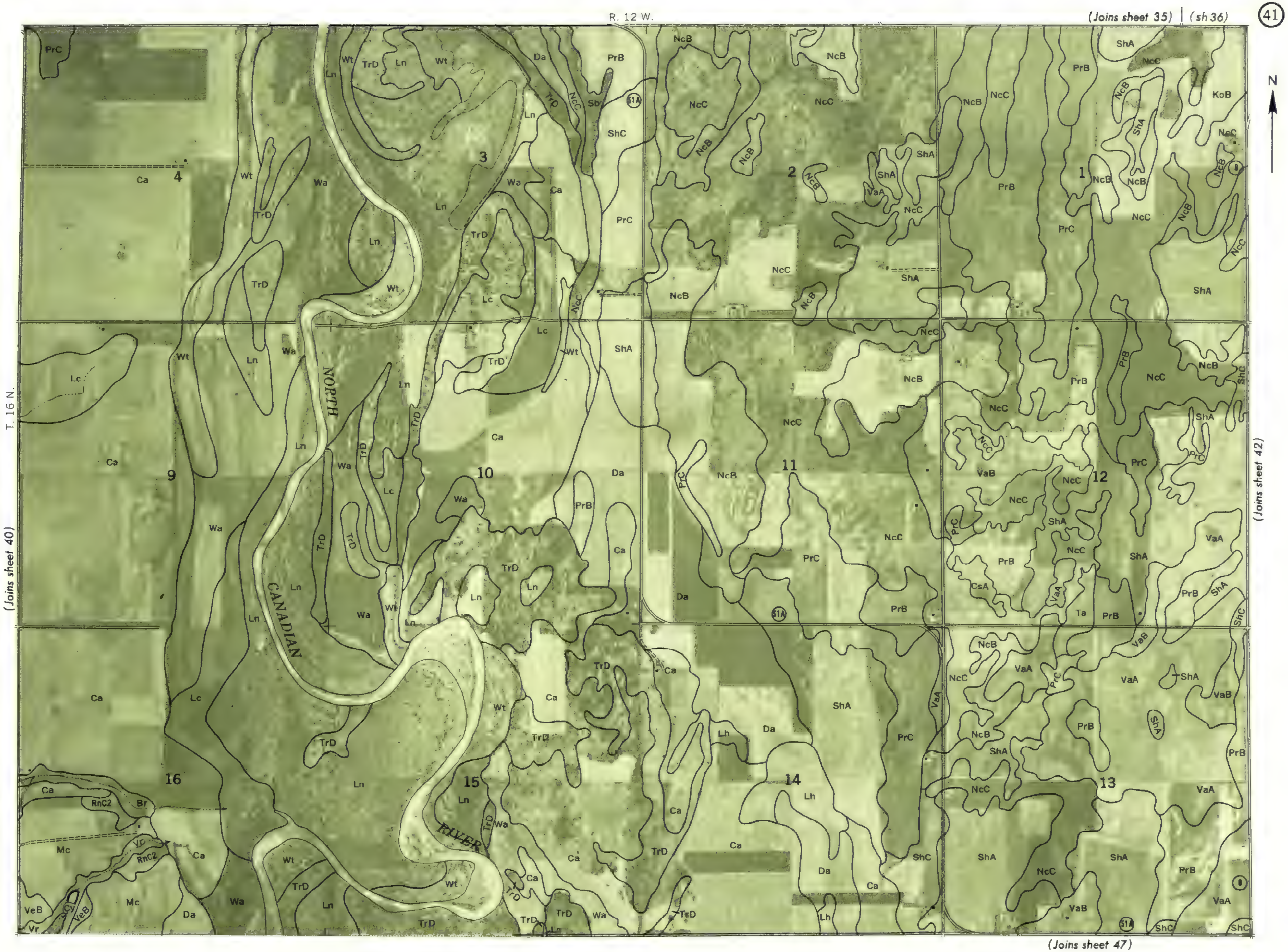
BLAINE COUNTY, OKLAHOMA NO. 39


4
N
(Joins inset A, sheet 1)
R. 13 W.
R. 12 W.
(Joins sheet 3)
(Joins sheet 5)
T. 19 N.
(Joins sheet 10)
OKLAHOMA GAME AND FISH AREA
Longdale
SANTA FE
AND
TOPEKA
ATCHISON
58
CsA
NcC
PrB
PrC
NcB
TrD
NcD
ShA
Sb
VeC
VeB
Vr
Bk
GrC
GrB
GrD
GrD2
RnC2
Er
Pc
Br
RcB
Ya
Ro
StD
1
2
5
6
7
8
11
12
13
14
17
18
0
½
1 Mile
Scale 1:20000
0
5000 Feet


40
N
R. 13 W. | R. 12 W.
(Joins sheet 34) | (sh35)
(Joins sheet 39)
(Joins sheet 41)
(Joins sheet 46)
T. 16 N.
1
2
5
6
7
8
11
12
13
14
17
18
SpB
SpA
GrB
GrC
GrD
GrD2
DfD
DfD2
DfB
DfA
QwF
Br
Er
Mc
VeC
VeB
Ca
Da
PrC
TrD
Lc
NsA
VaA
VaB
Ya
NcC
Lr
FaA
SpB
0
½
1 Mile
Scale 1:20000
0
5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

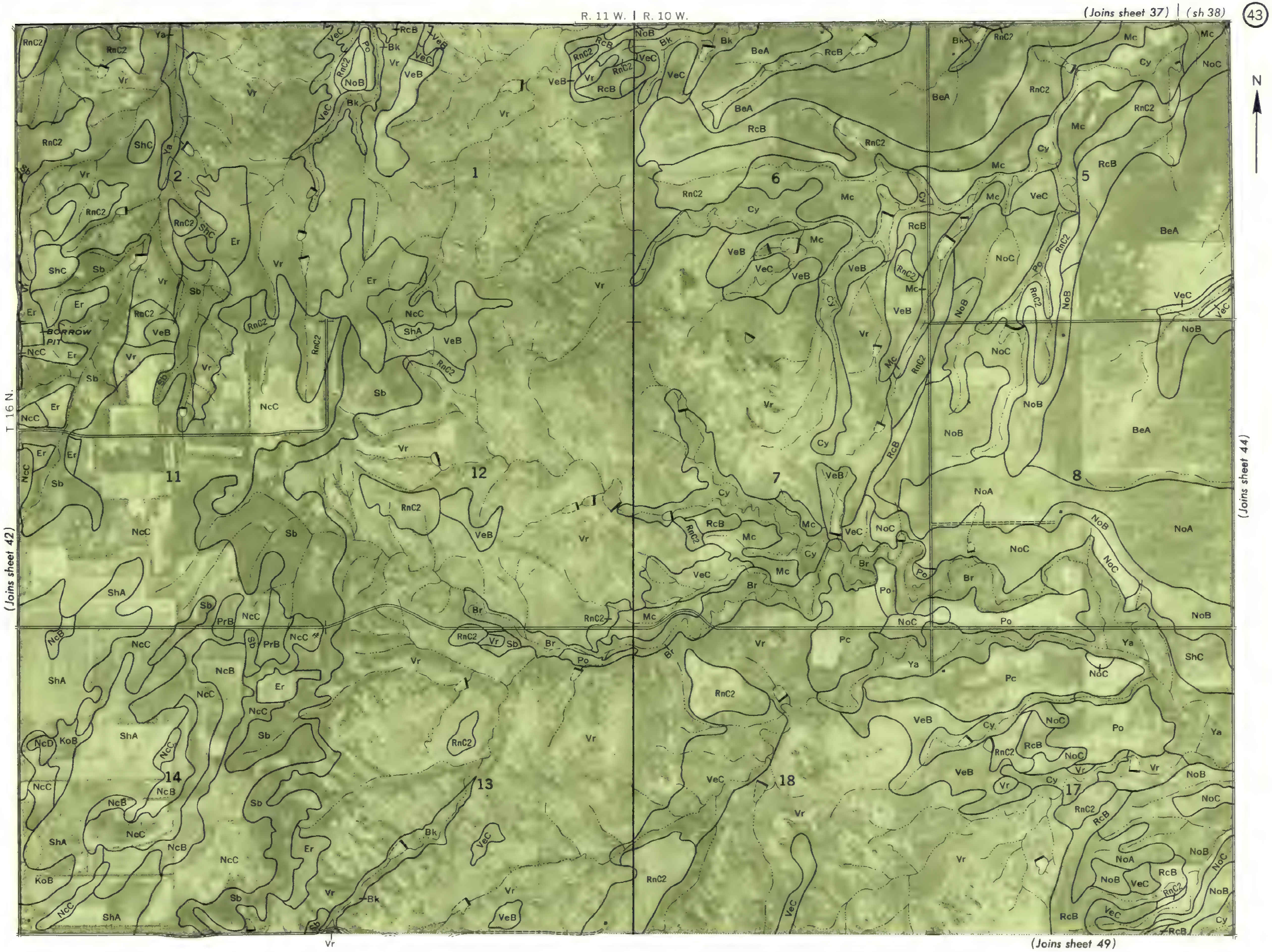
BLAINE COUNTY, OKLAHOMA NO. 41



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

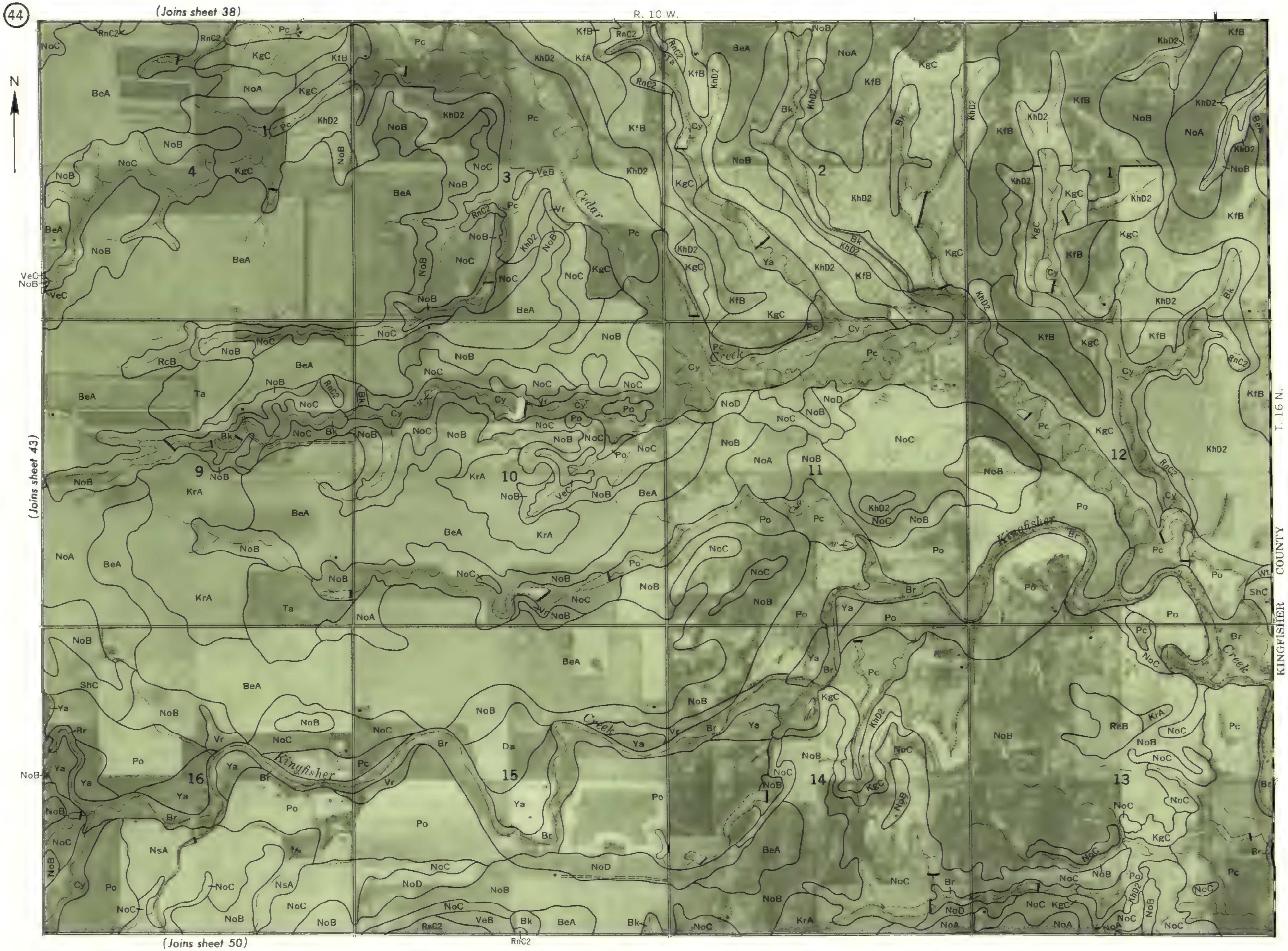
BLAINE COUNTY, OKLAHOMA — SHEET NUMBER 43



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

BLAINE COUNTY, OKLAHOMA NO. 43

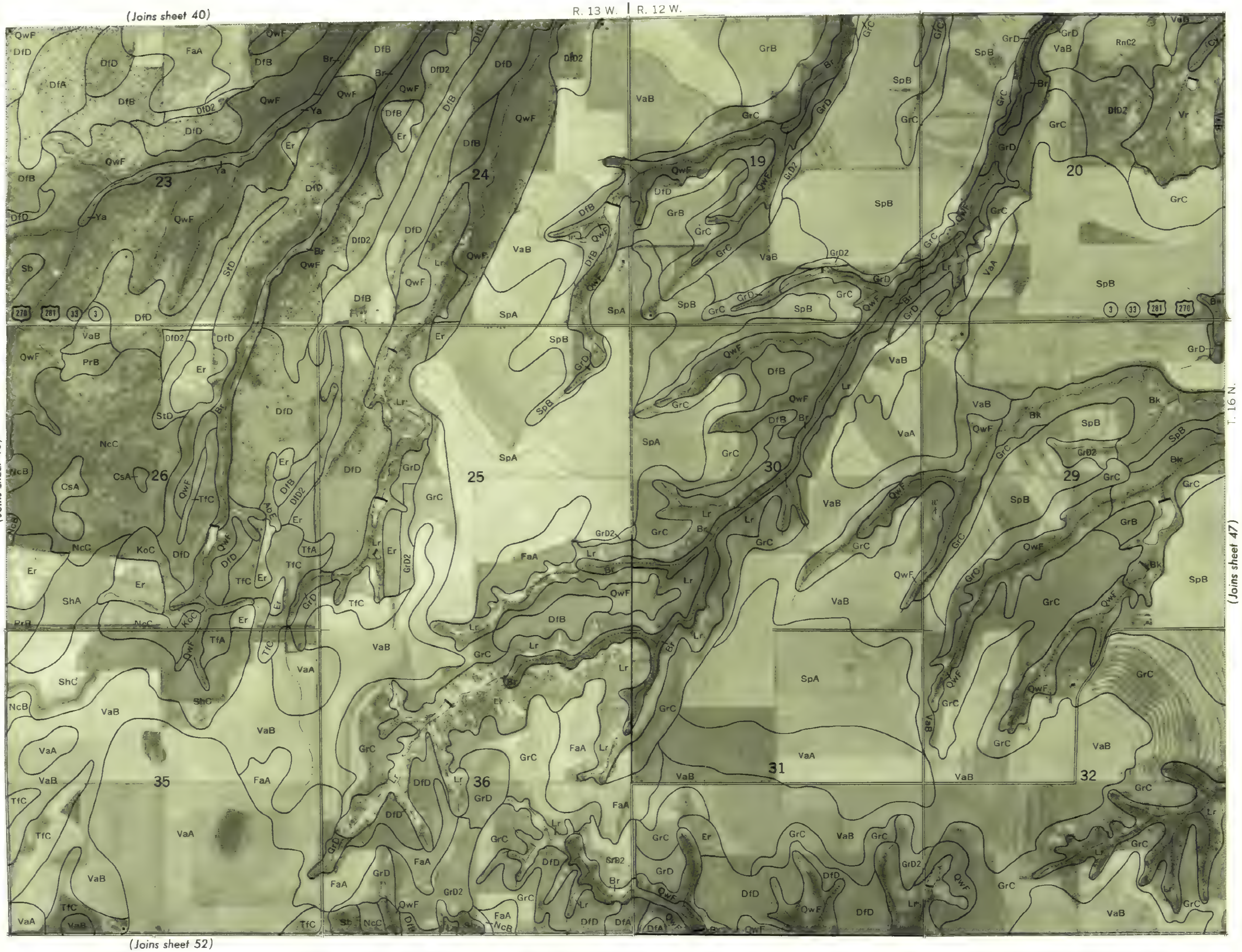


0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

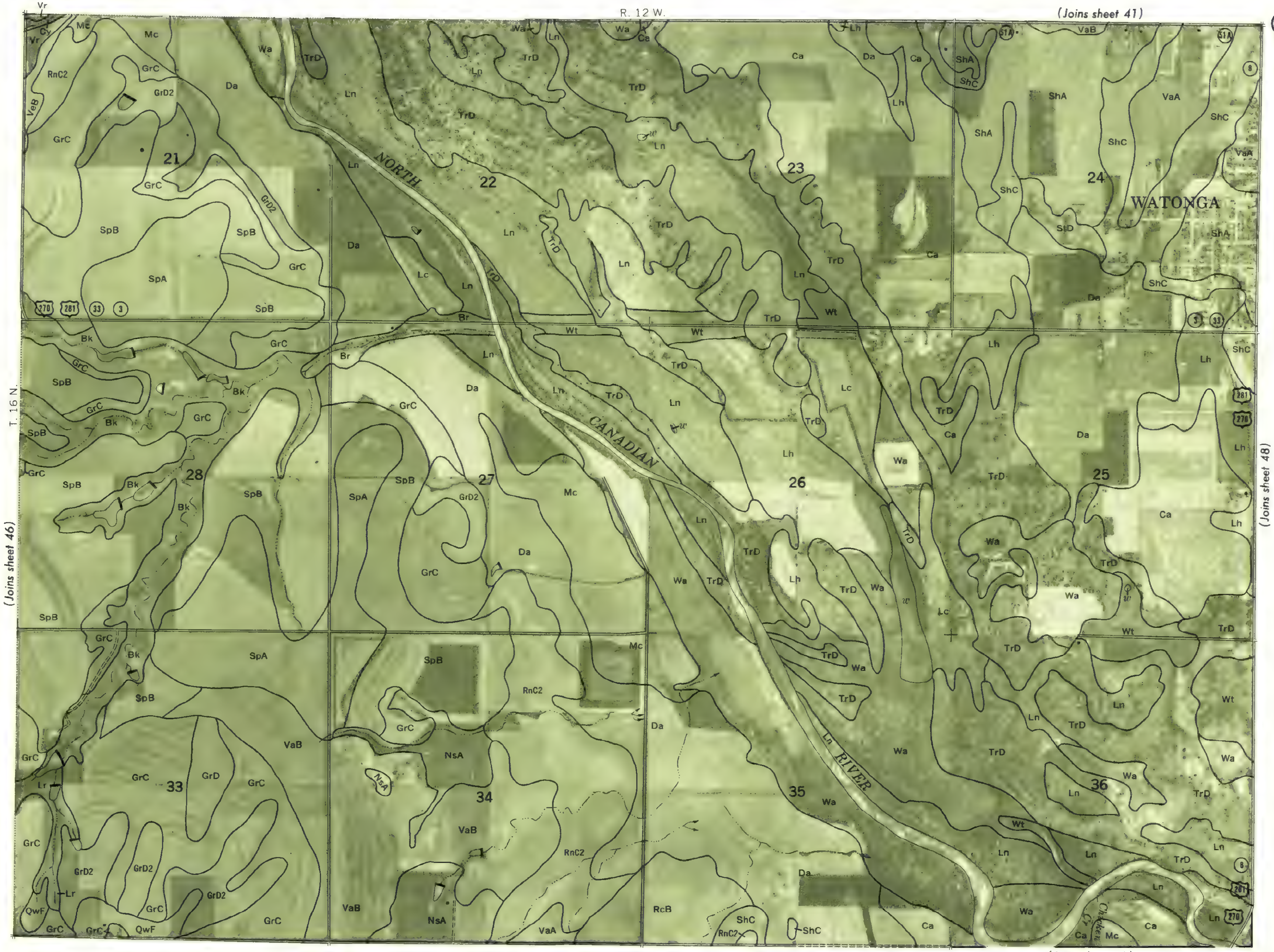
46



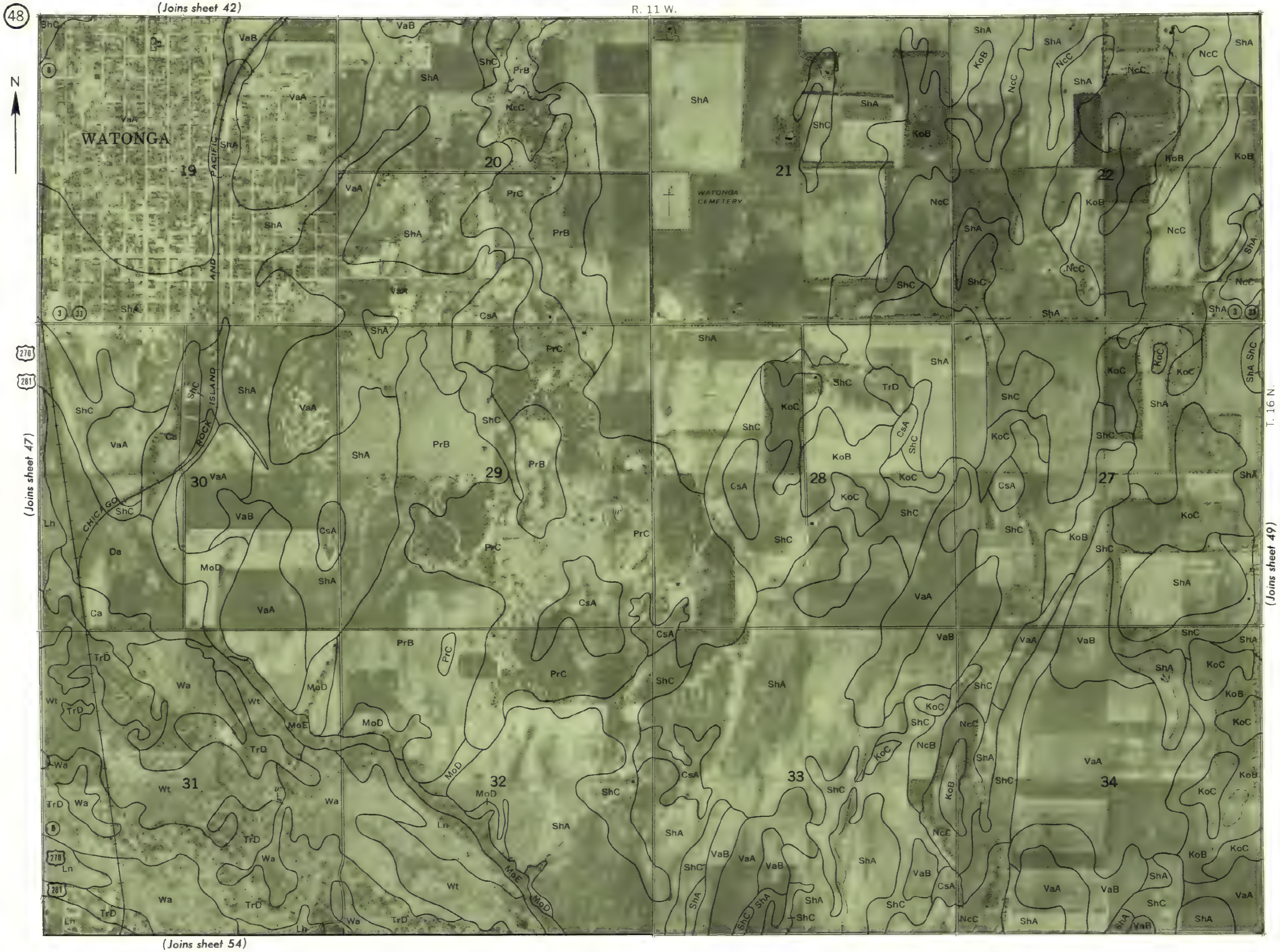
0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

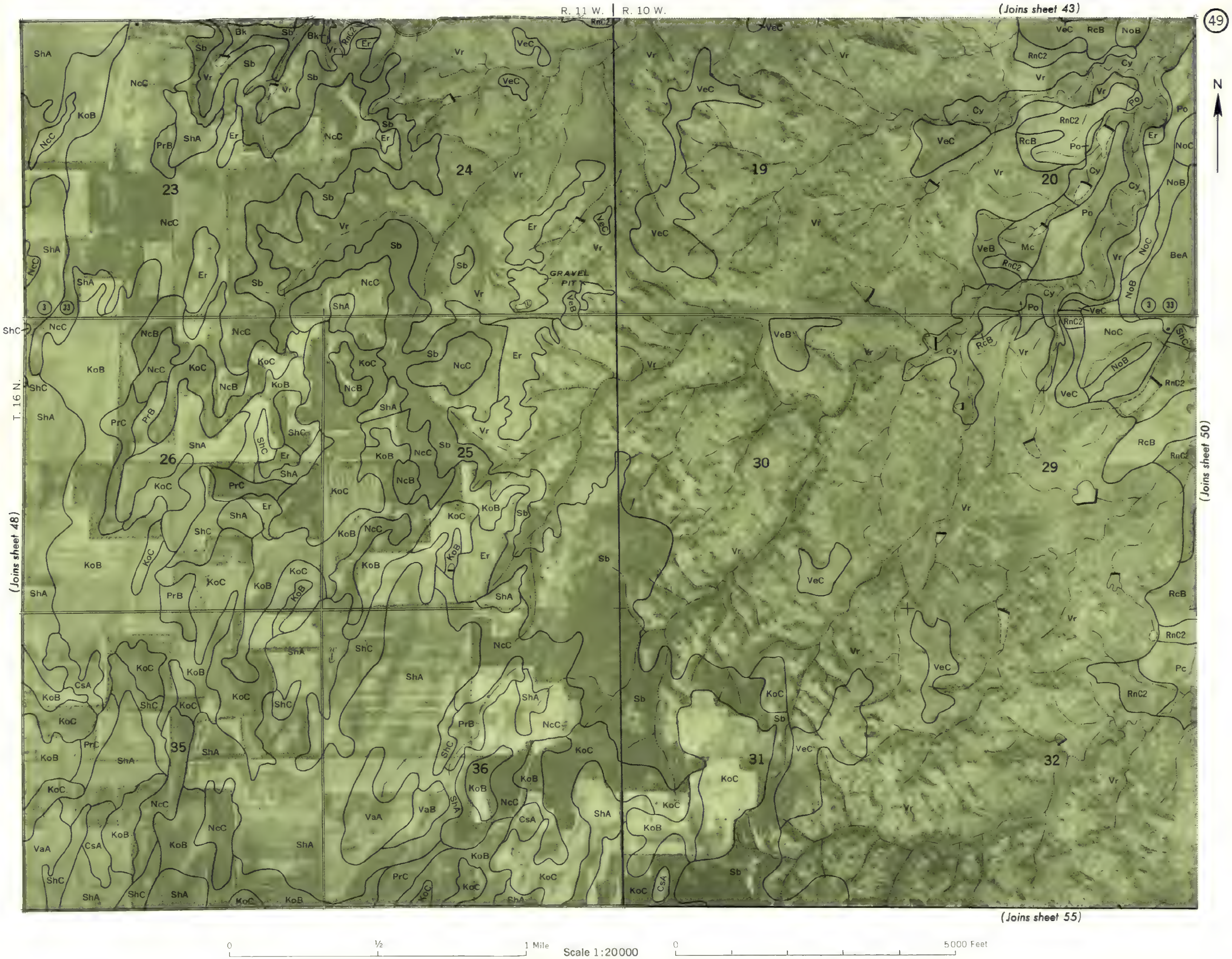
BLAINE COUNTY, OKLAHOMA NO. 47



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

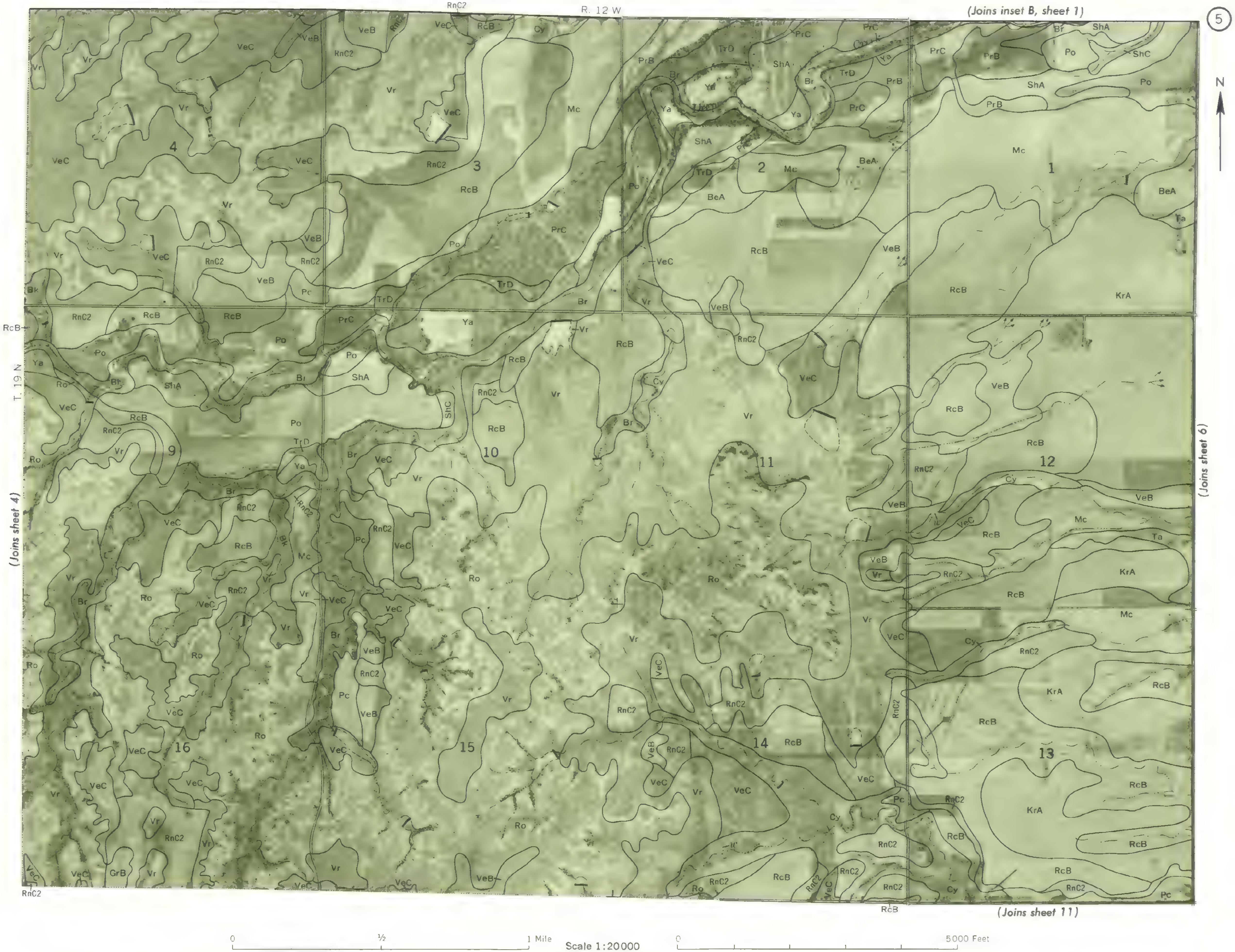


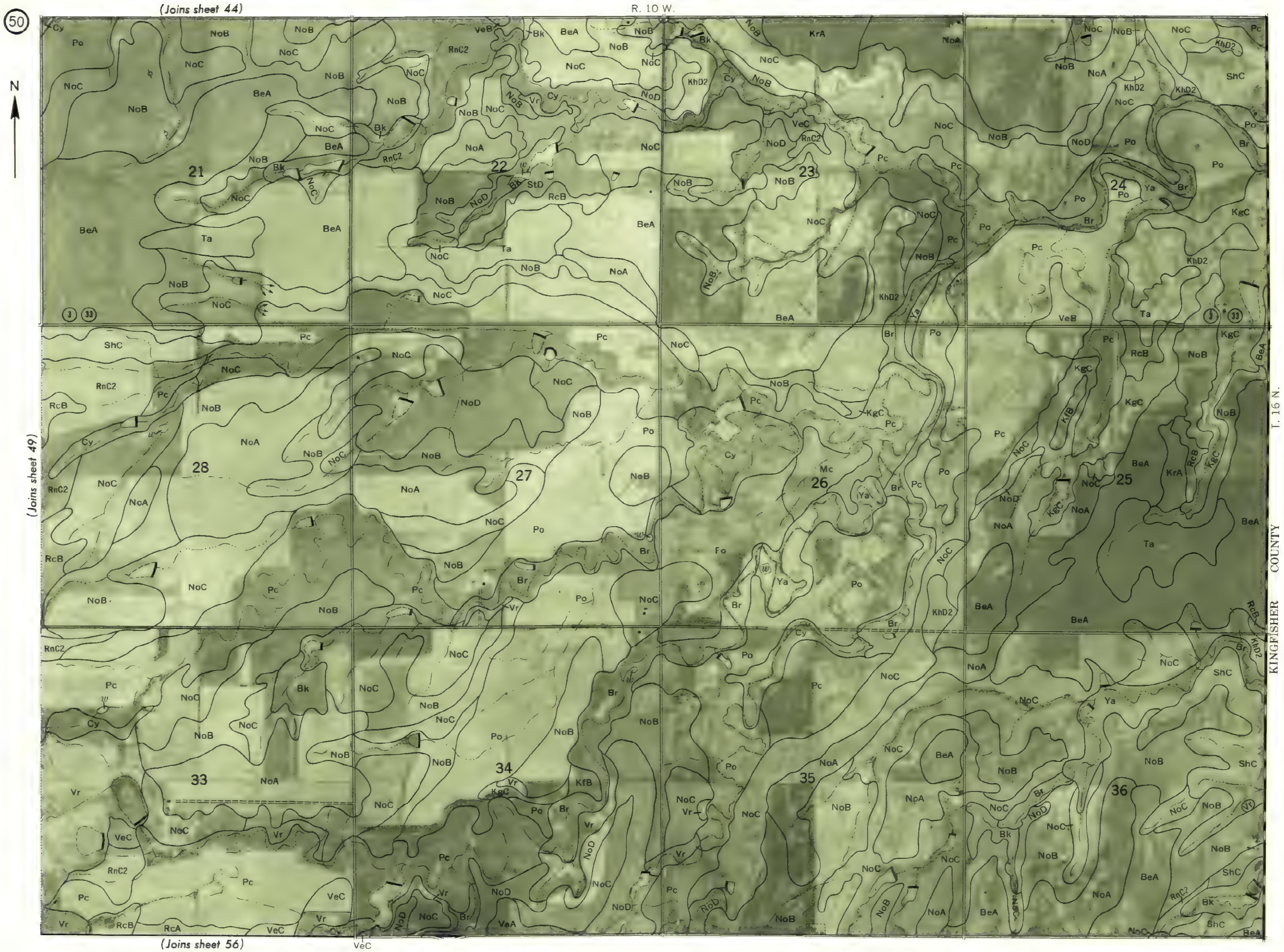
0 ½ 1 Mile Scale 1:20000 0 5000 Feet



This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station
Range, township, and section corners shown on this map are indefinite.

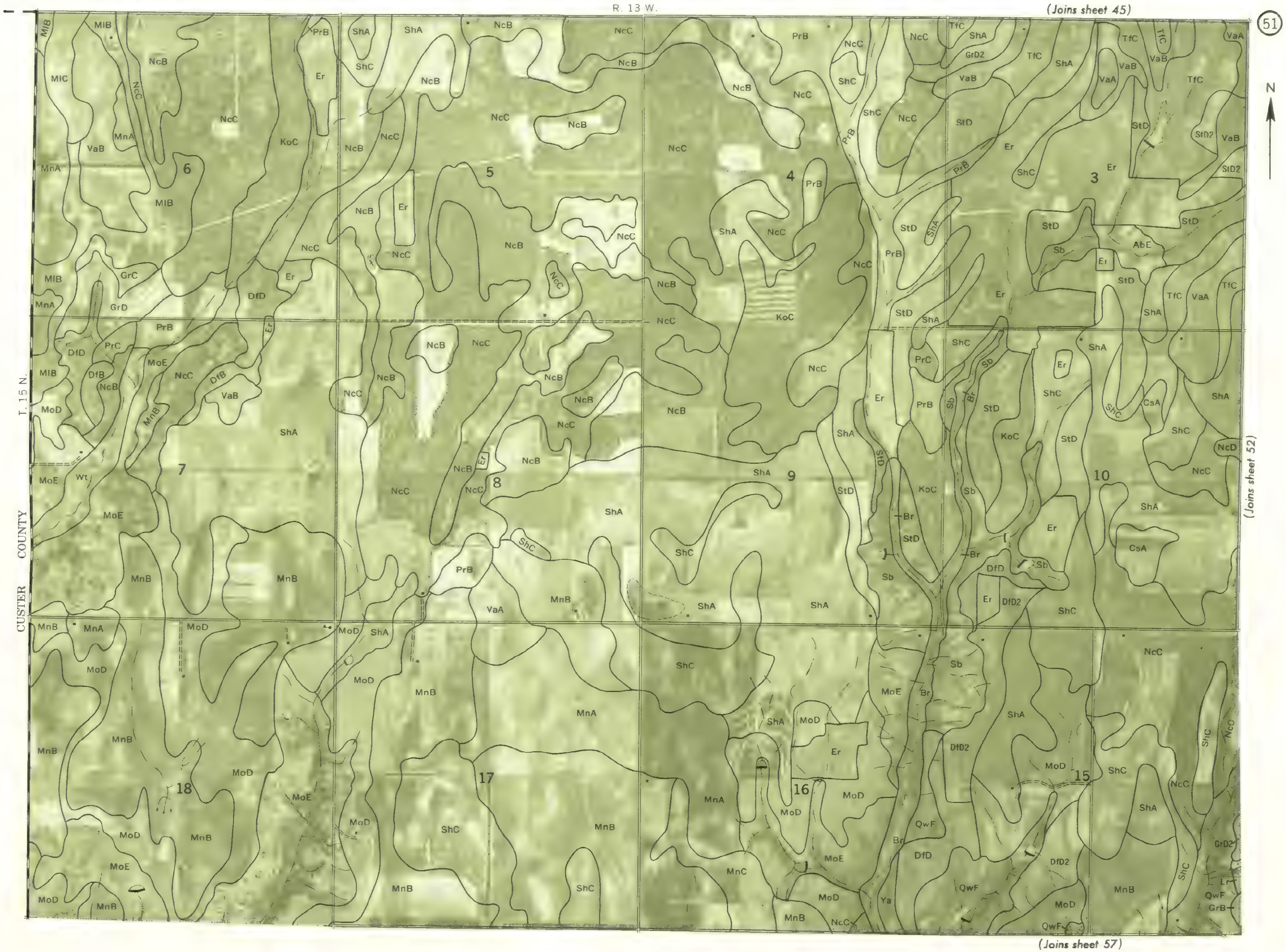
BLAINE COUNTY, OKLAHOMA NO. 49


5
R. 12 W.
T. 19 N.
(Joins inset B, sheet 1)
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 11)
N
1
2
3
4
9
10
11
12
13
14
15
16
0 ½ 1 Mile
Scale 1:20000
0 5000 Feet



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

BLAINE COUNTY, OKLAHOMA — SHEET NUMBER 51



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

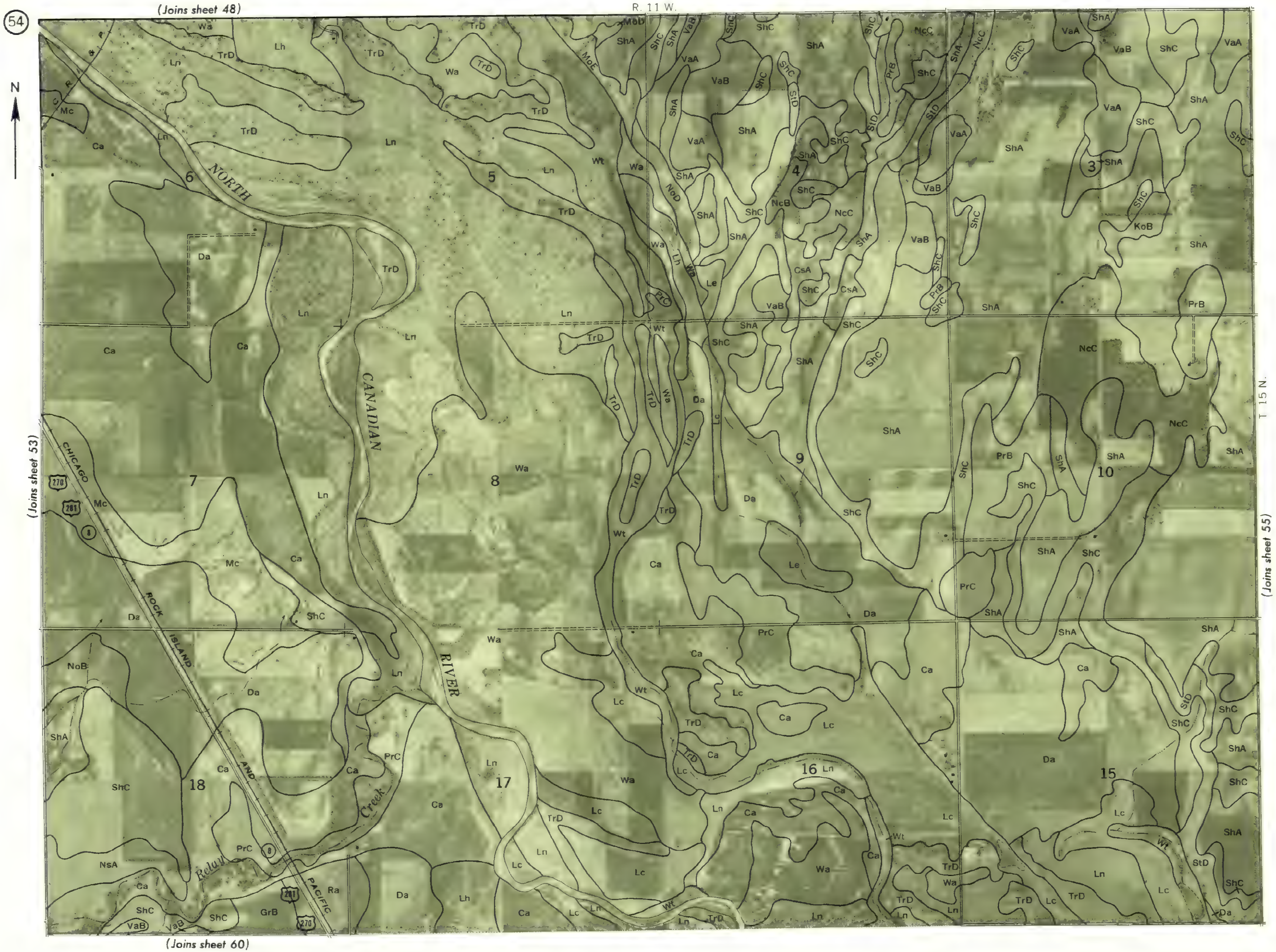
This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

BLAINE COUNTY, OKLAHOMA NO. 51

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

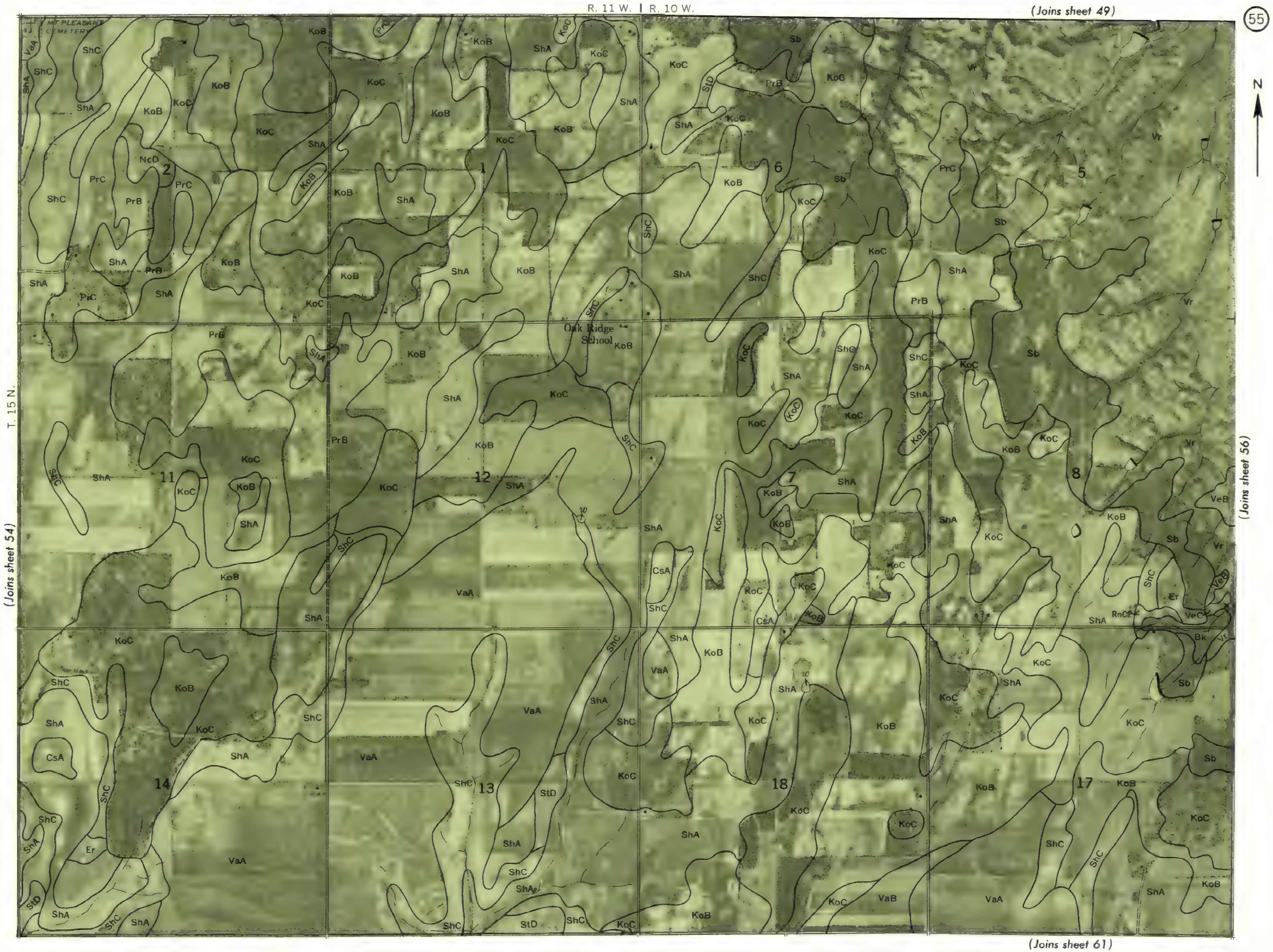
This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station
Range, township, and section corners shown on this map are indefinite.
BLAINE COUNTY, OKLAHOMA NO. 53

0 ½ 1 Mile Scale 1:20000 0 5000 Feet



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

BLAINE COUNTY, OKLAHOMA NO. 54



0 ½ 1 Mile Scale 1:20000 0 5000 Feet


56
(Joins sheet 50)
R. 10 W.
N
(Joins sheet 55)
T. 15 N.
KINGFISHER COUNTY
(Joins sheet 62)
0 ½ 1 Mile
Scale 1:20000
0 5000 Feet

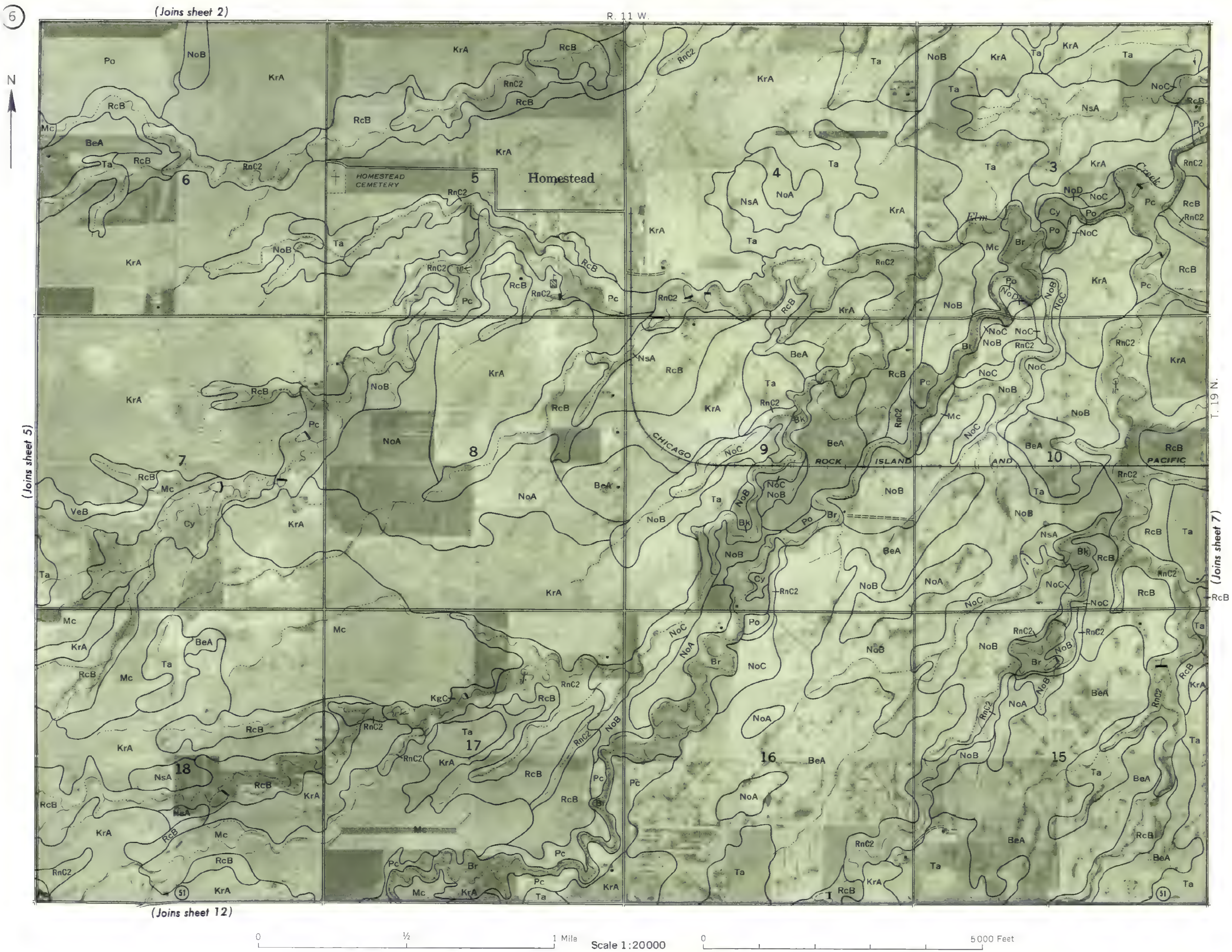
0 ½ 1 Mile Scale 1:20000 0 5000 Feet

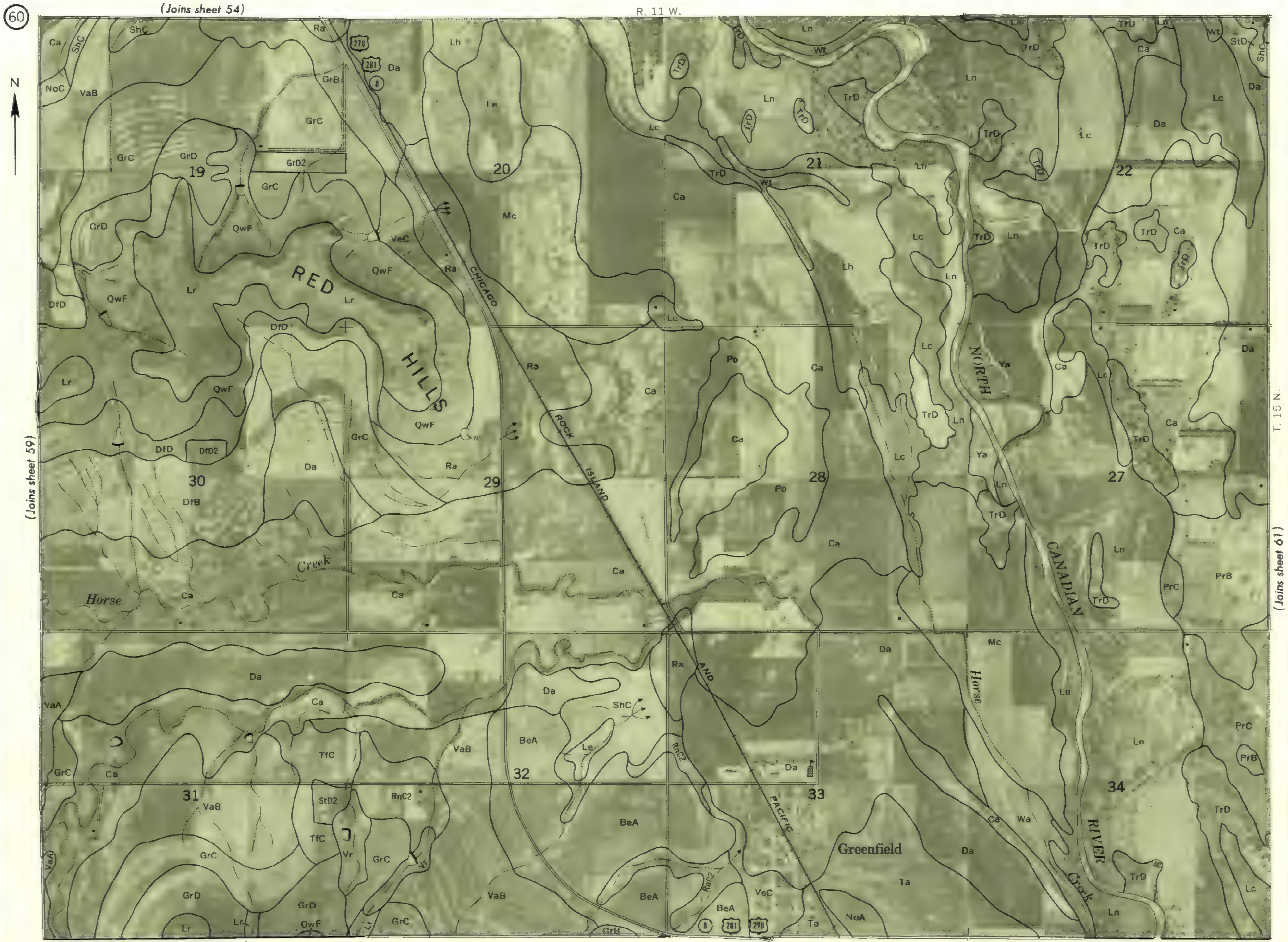
This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

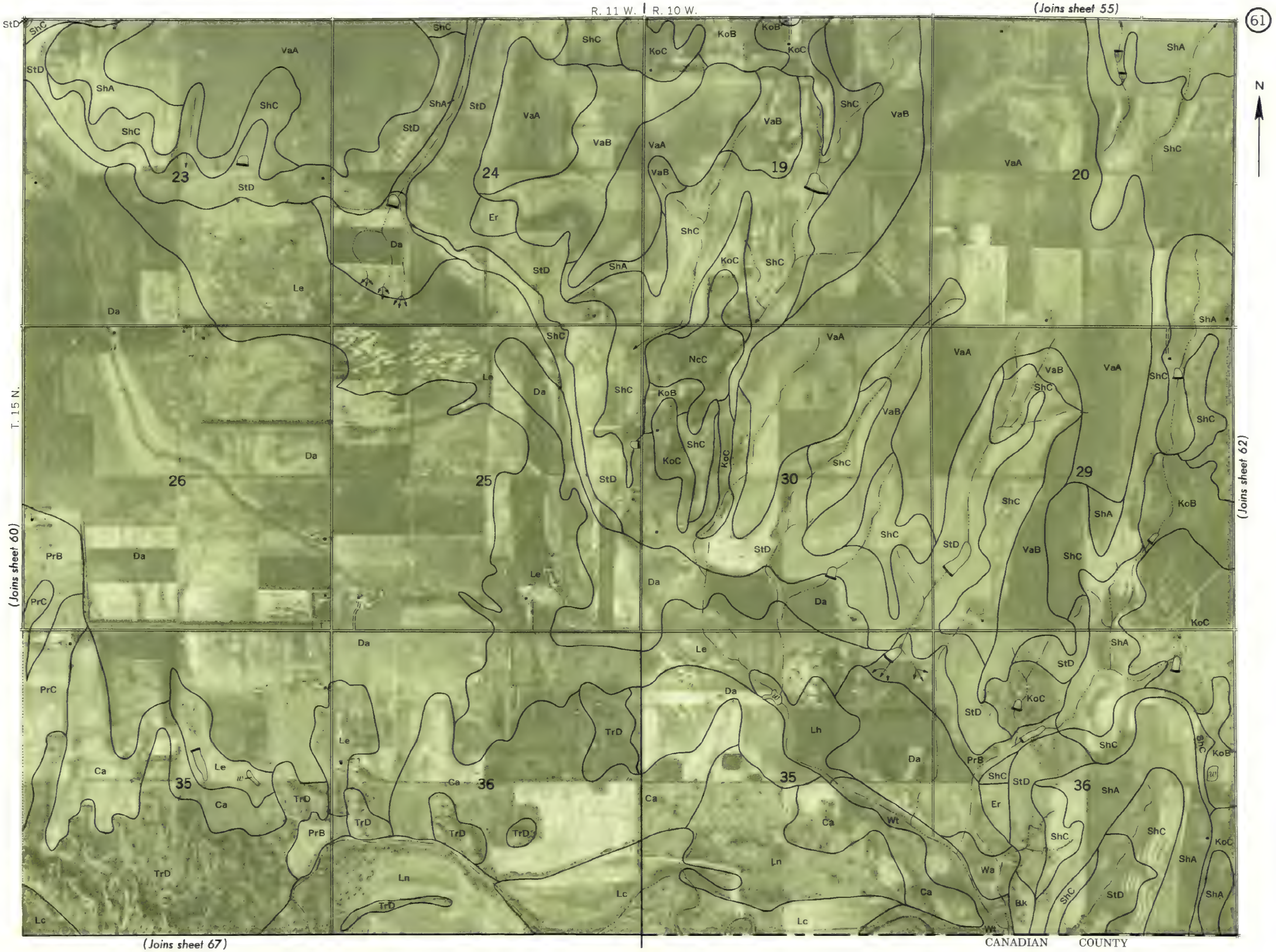
This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

BLAINE COUNTY, OKLAHOMA NO. 59


6
(Joins sheet 2)
R. 11 W.
N
(Joins sheet 5)
(Joins sheet 7)
T. 19 N.
(Joins sheet 12)
Homestead
HOMESTEAD CEMETERY
CHICAGO ROCK ISLAND AND PACIFIC
Elm Creek
0 ½ 1 Mile
Scale 1:20000
0 5000 Feet



0 ½ 1 Mile Scale 1:20000 0 5000 Feet



0 ½ 1 Mile

Scale 1:20000

0 5000 Feet

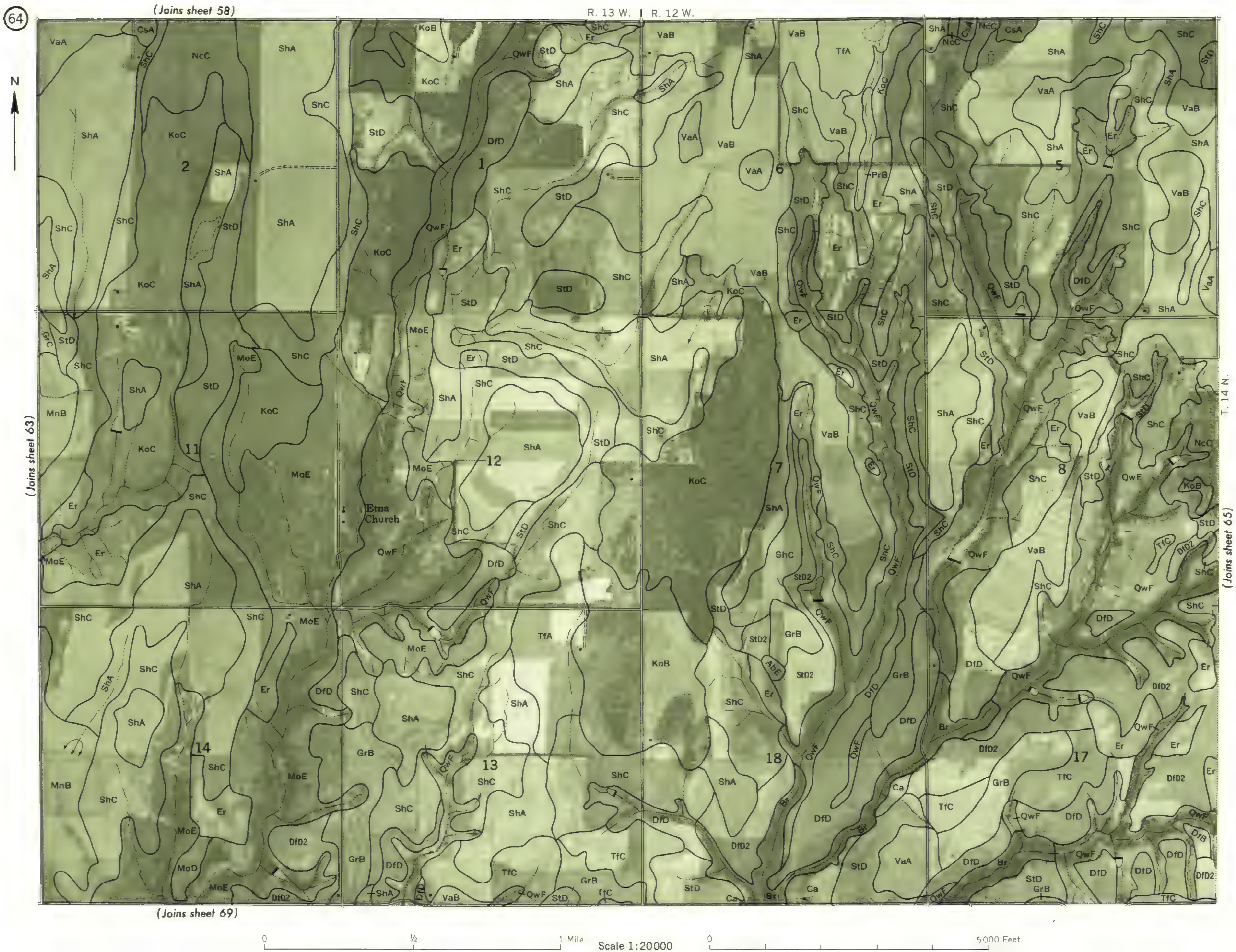
This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.



BLAINE COUNTY, OKLAHOMA NO. 64

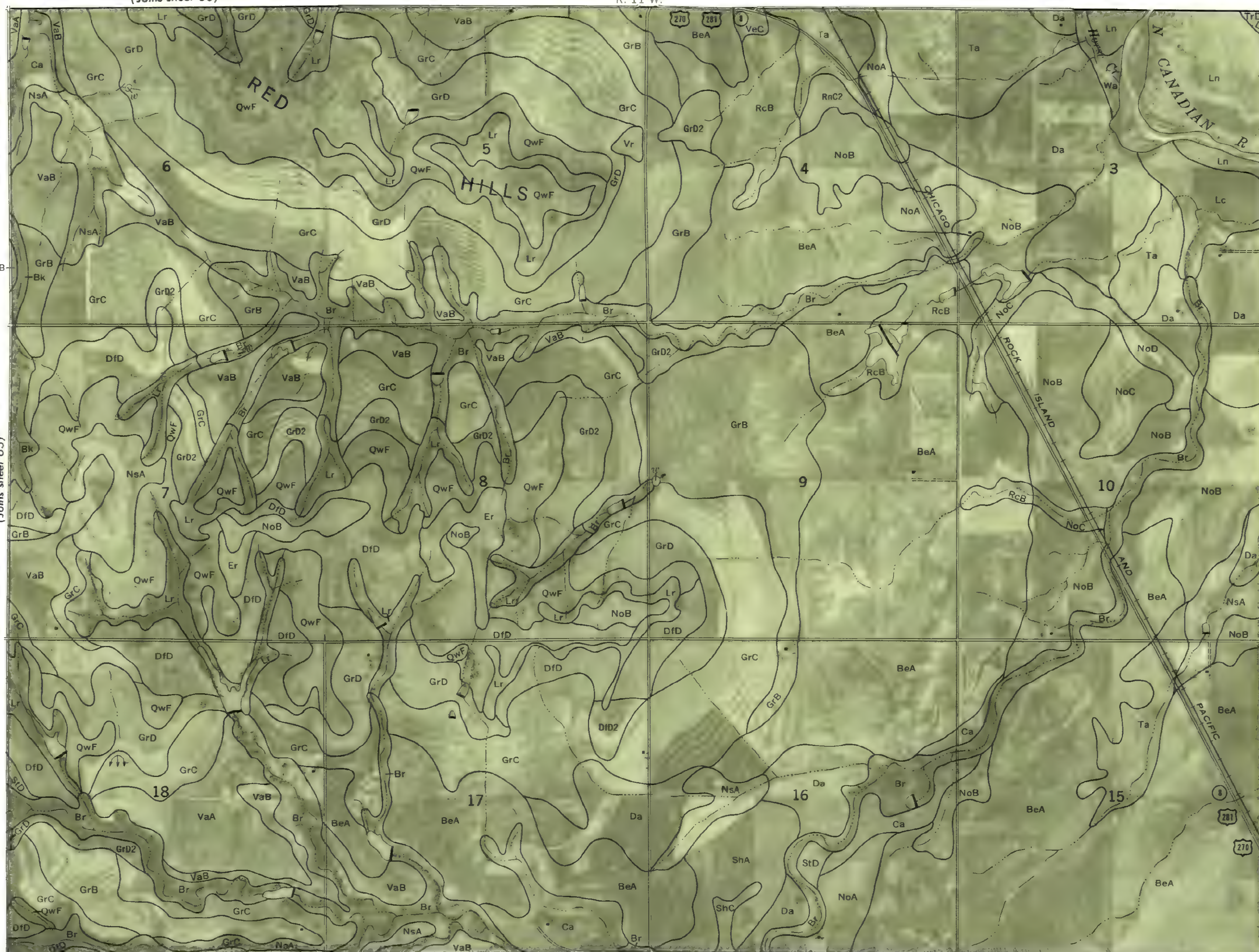
This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

BLAINE COUNTY, OKLAHOMA NO. 65

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

(66)

(Joins sheet 60)



(Joins sheet 71)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

(Joins sheet 61) R. 11 W.

(Joins upper right)

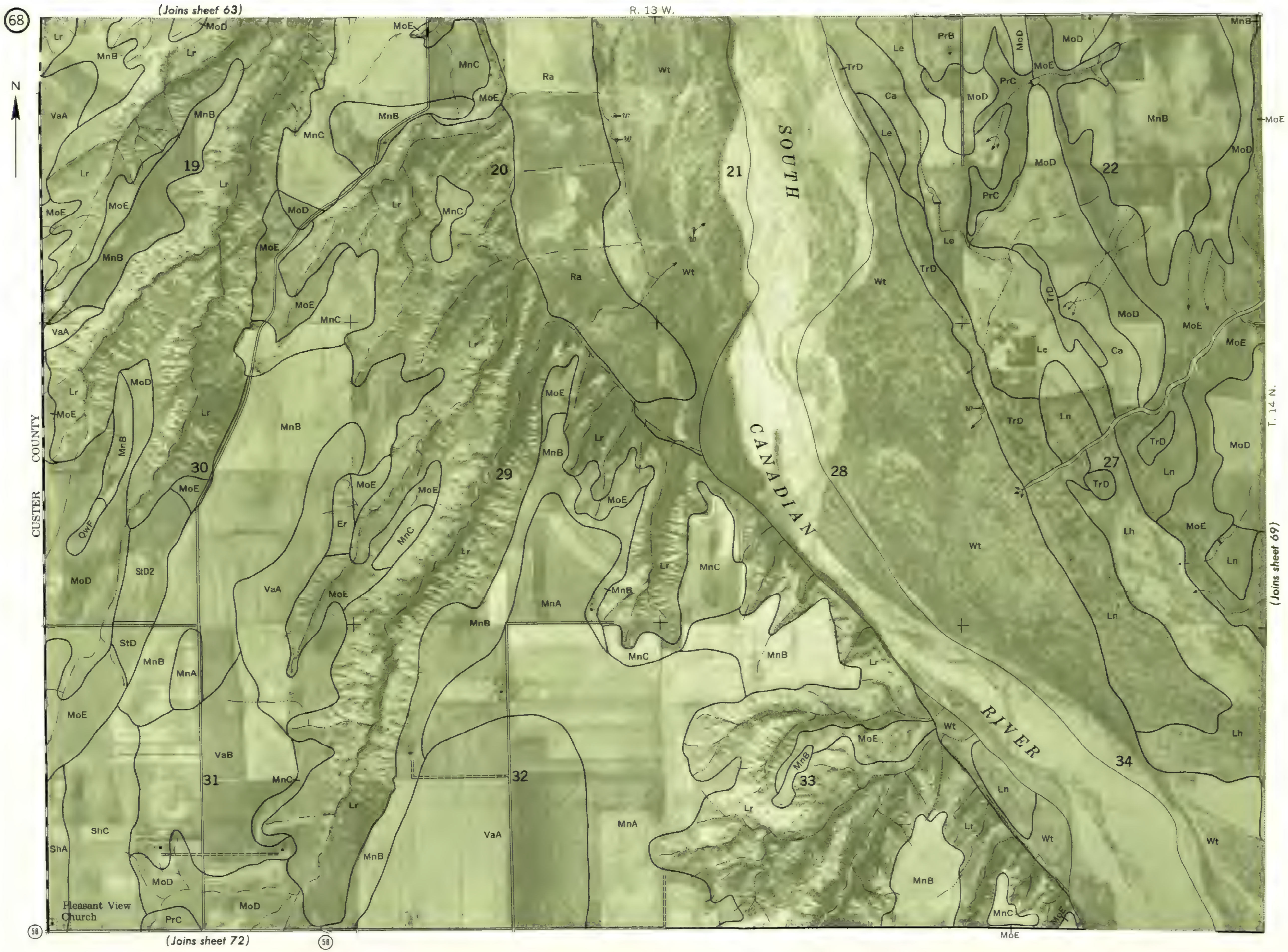
R. 11 W. (Joins lower left) 67

(Joins inset, sheet 80)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

BLAINE COUNTY, OKLAHOMA NO. 67



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

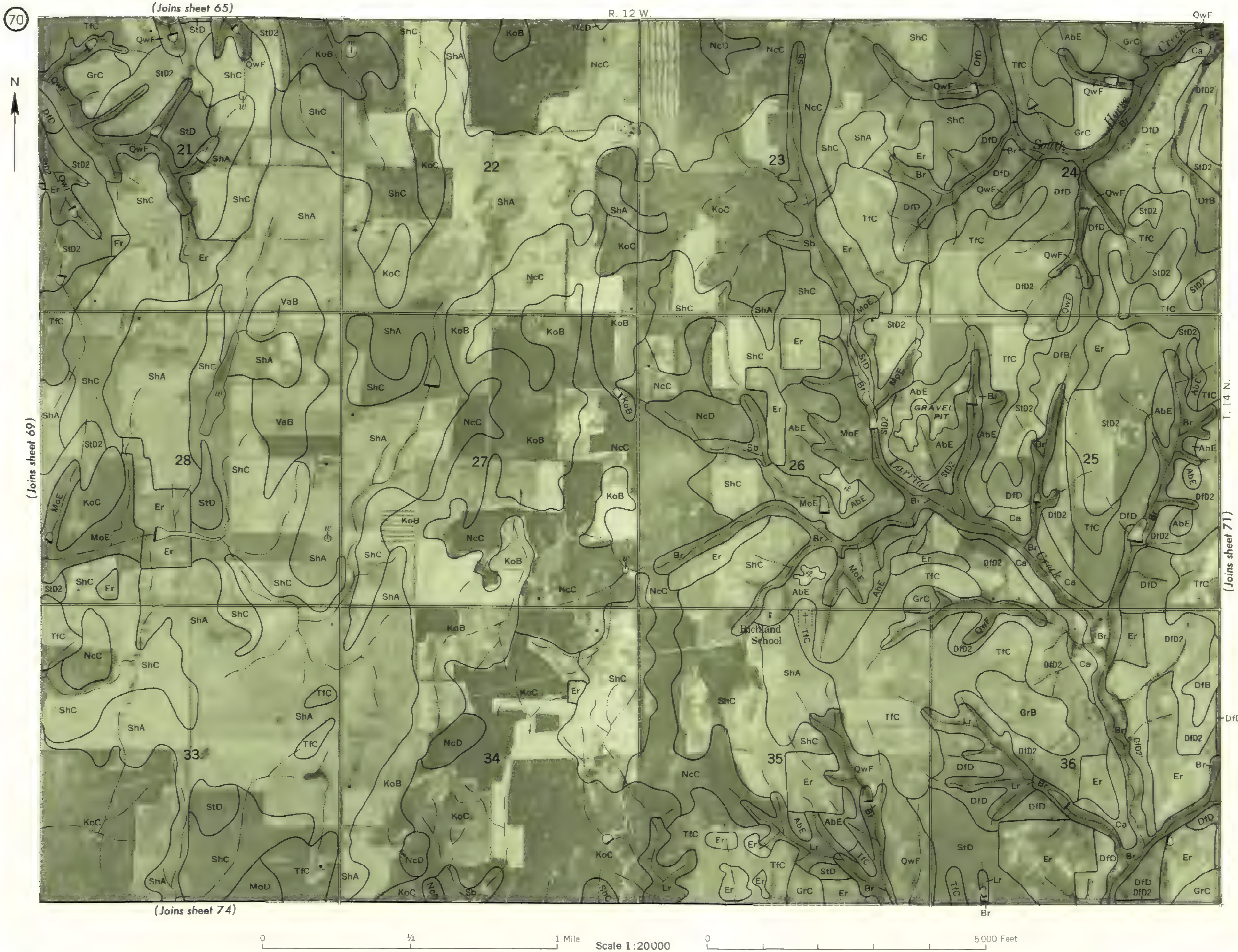
BLAINE COUNTY, OKLAHOMA NO. 69

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

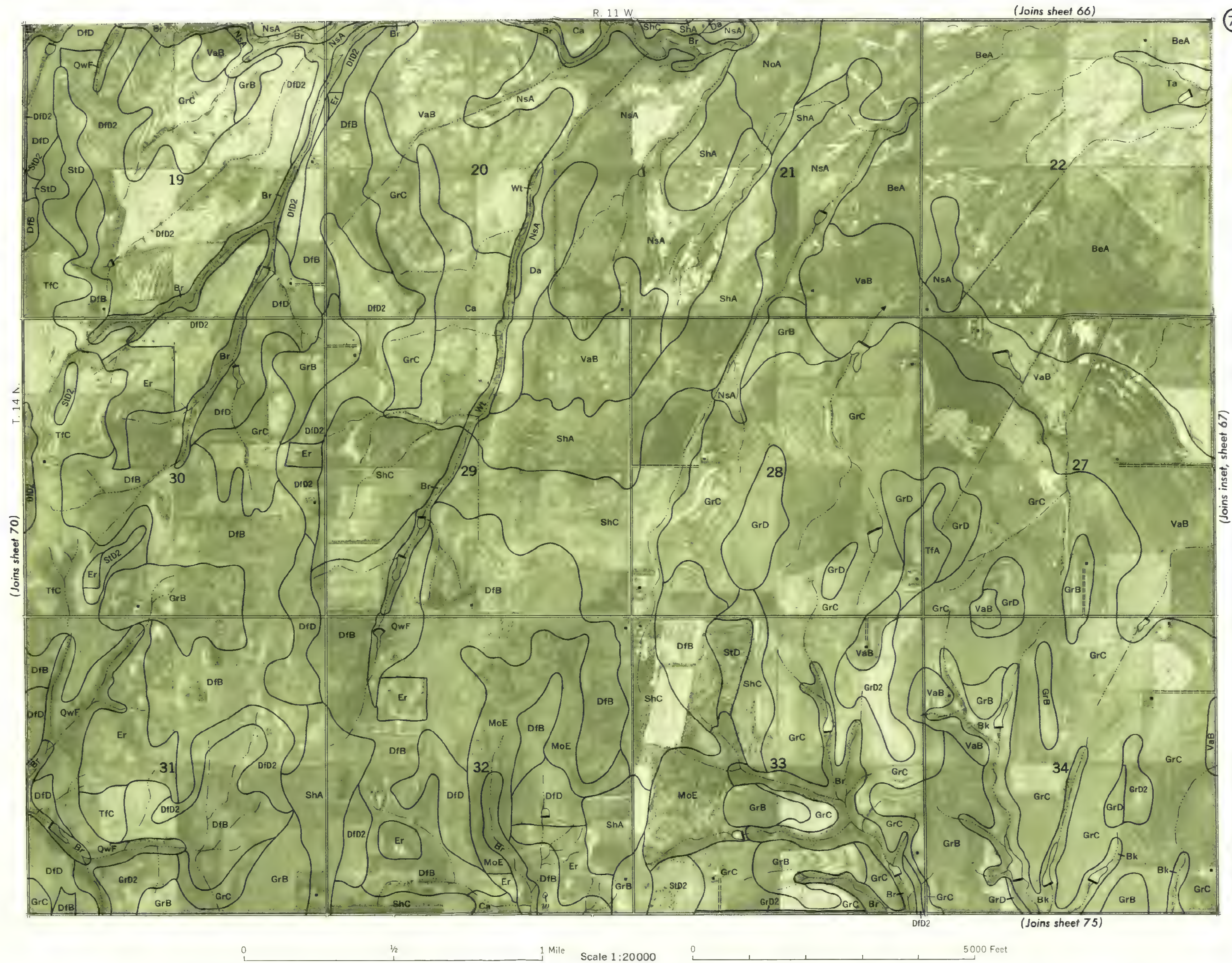
BLAINE COUNTY, OKLAHOMA NO. 7

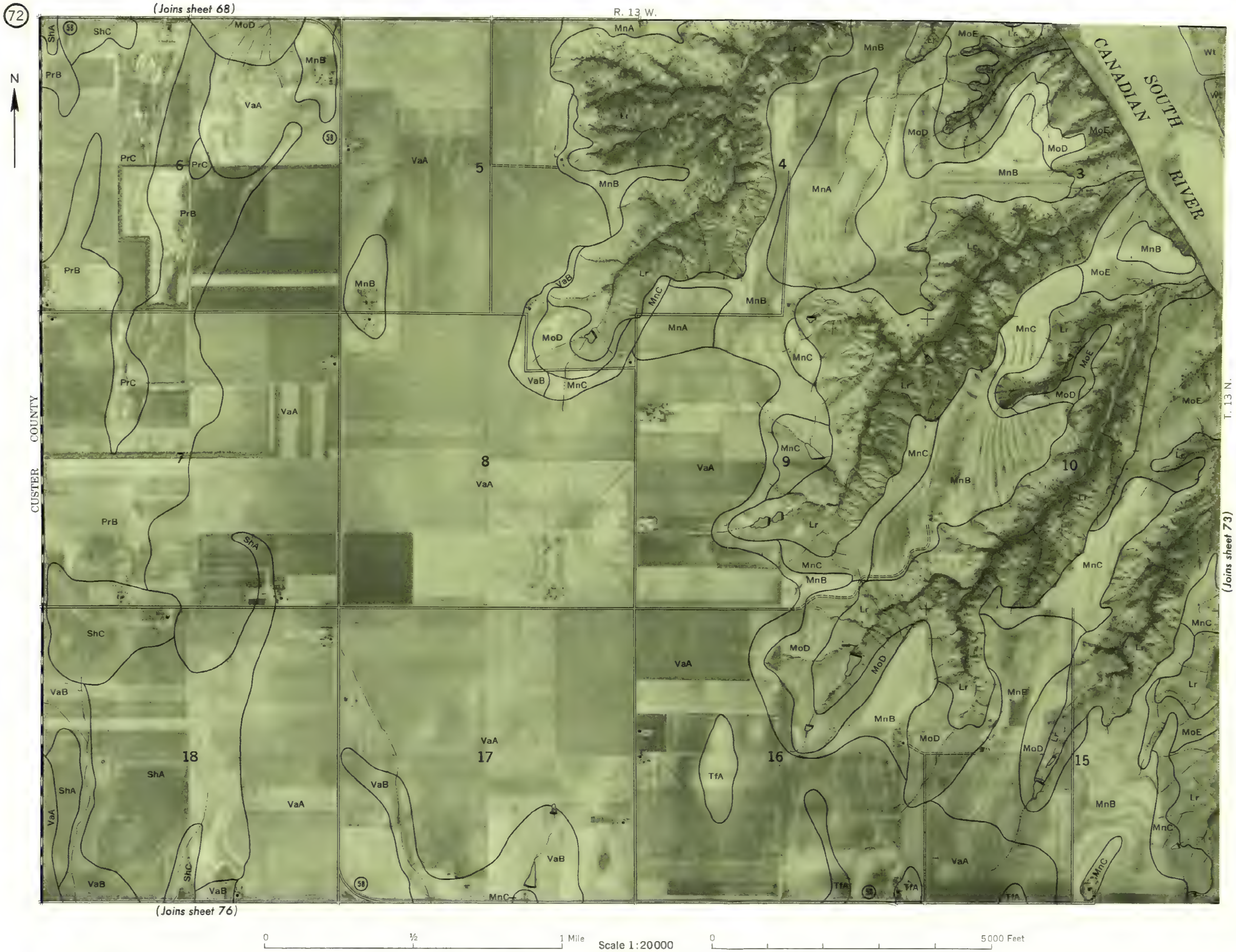

70
(Joins sheet 65)
(Joins sheet 69)
(Joins sheet 71)
(Joins sheet 74)
R. 12 W.
T. 14 N.
N
21
22
23
24
25
26
27
28
33
34
35
36
Richland School
GRAVEL PIT
South Horse Creek
Larrian Creek
0
½
1 Mile
Scale 1:20000
0
5000 Feet

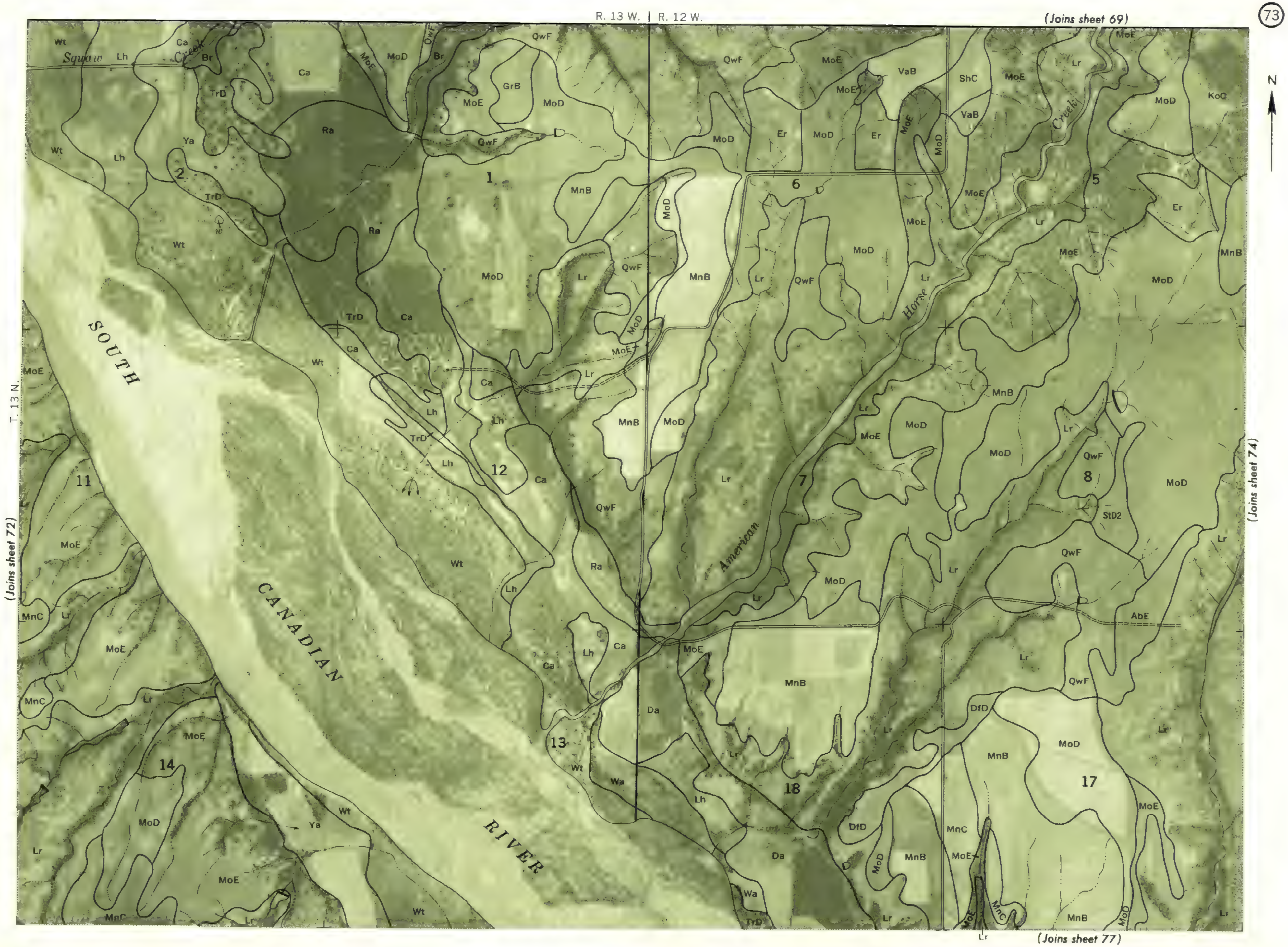
BLAINE COUNTY, OKLAHOMA — SHEET NUMBER 71

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station
Range, township, and section corners shown on this map are indefinite.

BLAINE COUNTY, OKLAHOMA NO. 71



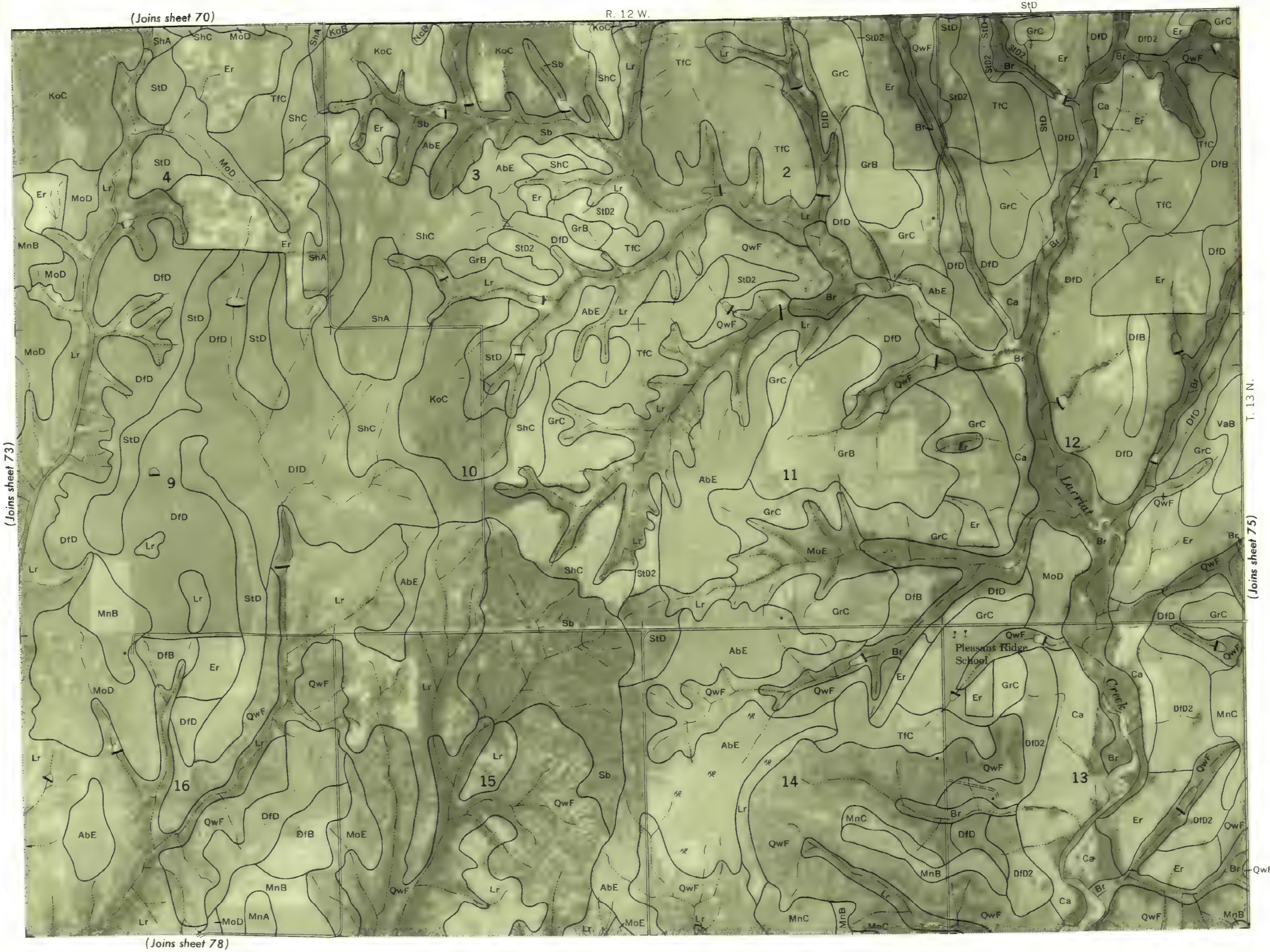

72
(Joins sheet 68)
R. 13 W.
N
CUSTER COUNTY
SOUTH CANADIAN RIVER
T. 13 N.
(Joins sheet 73)
(Joins sheet 76)
0
½
1 Mile
Scale 1:20000
0
5000 Feet



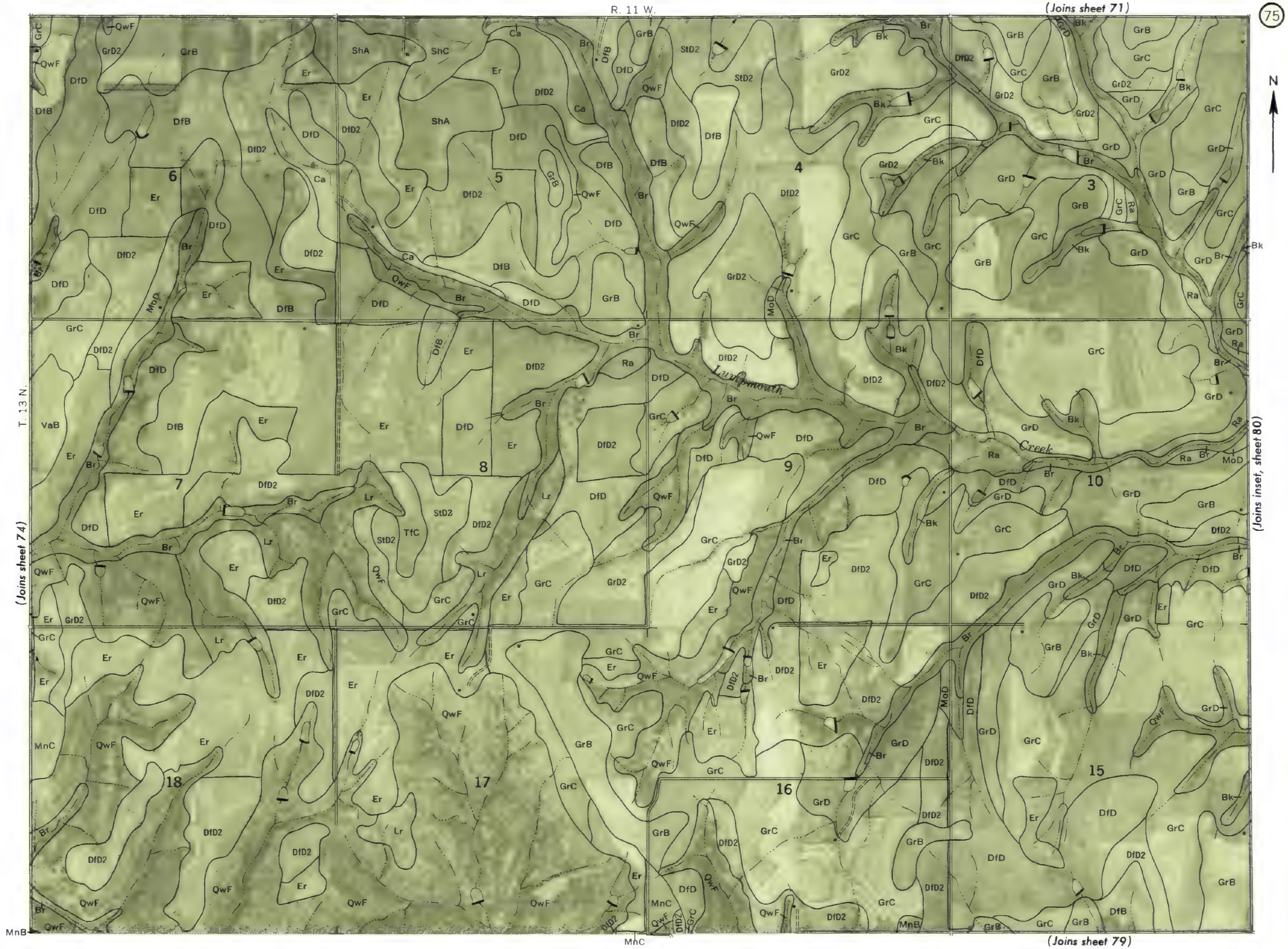
0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

74



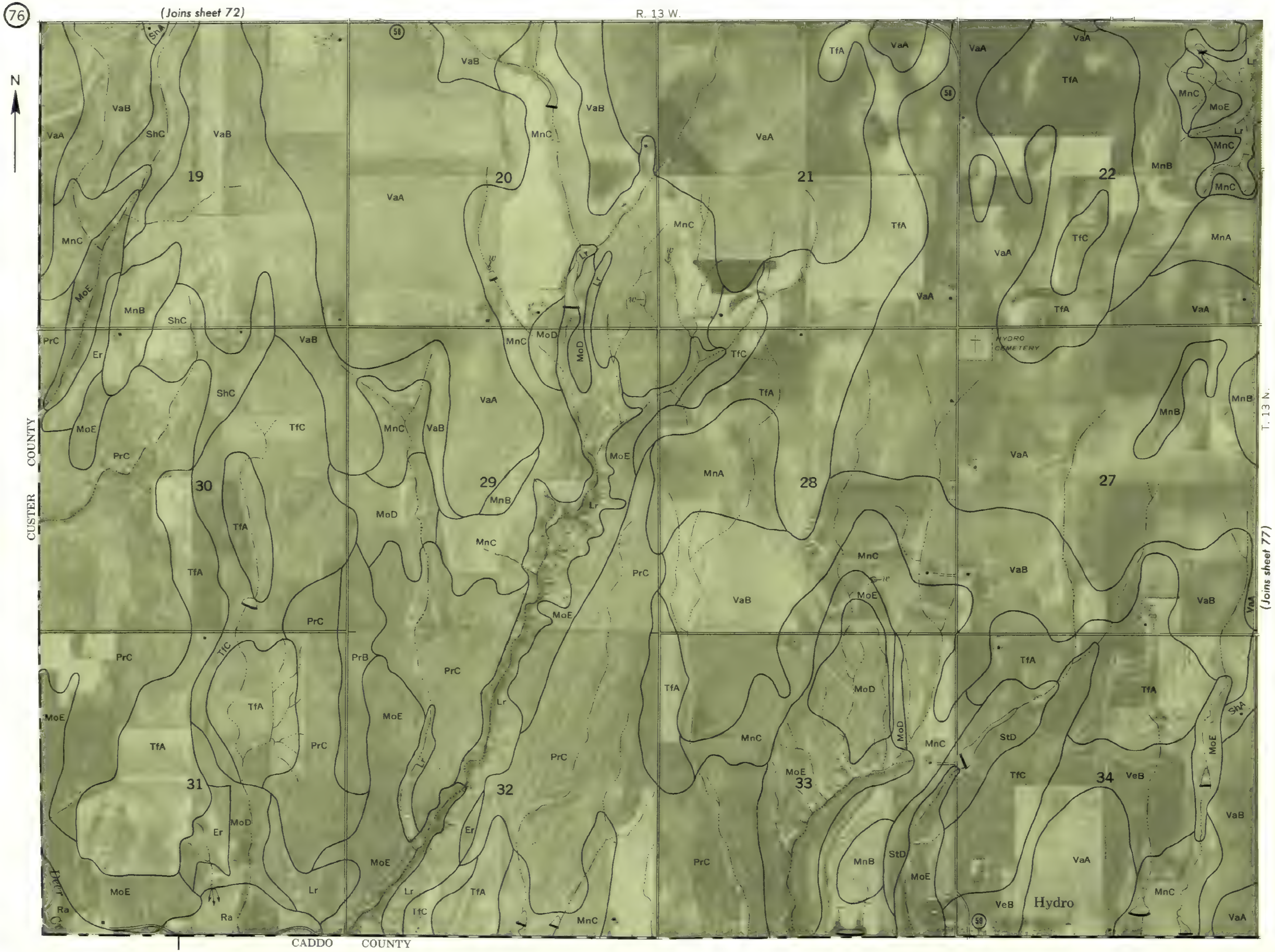
0 ½ 1 Mile Scale 1:20000 0 5000 Feet



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

BLAINE COUNTY, OKLAHOMA NO. 75



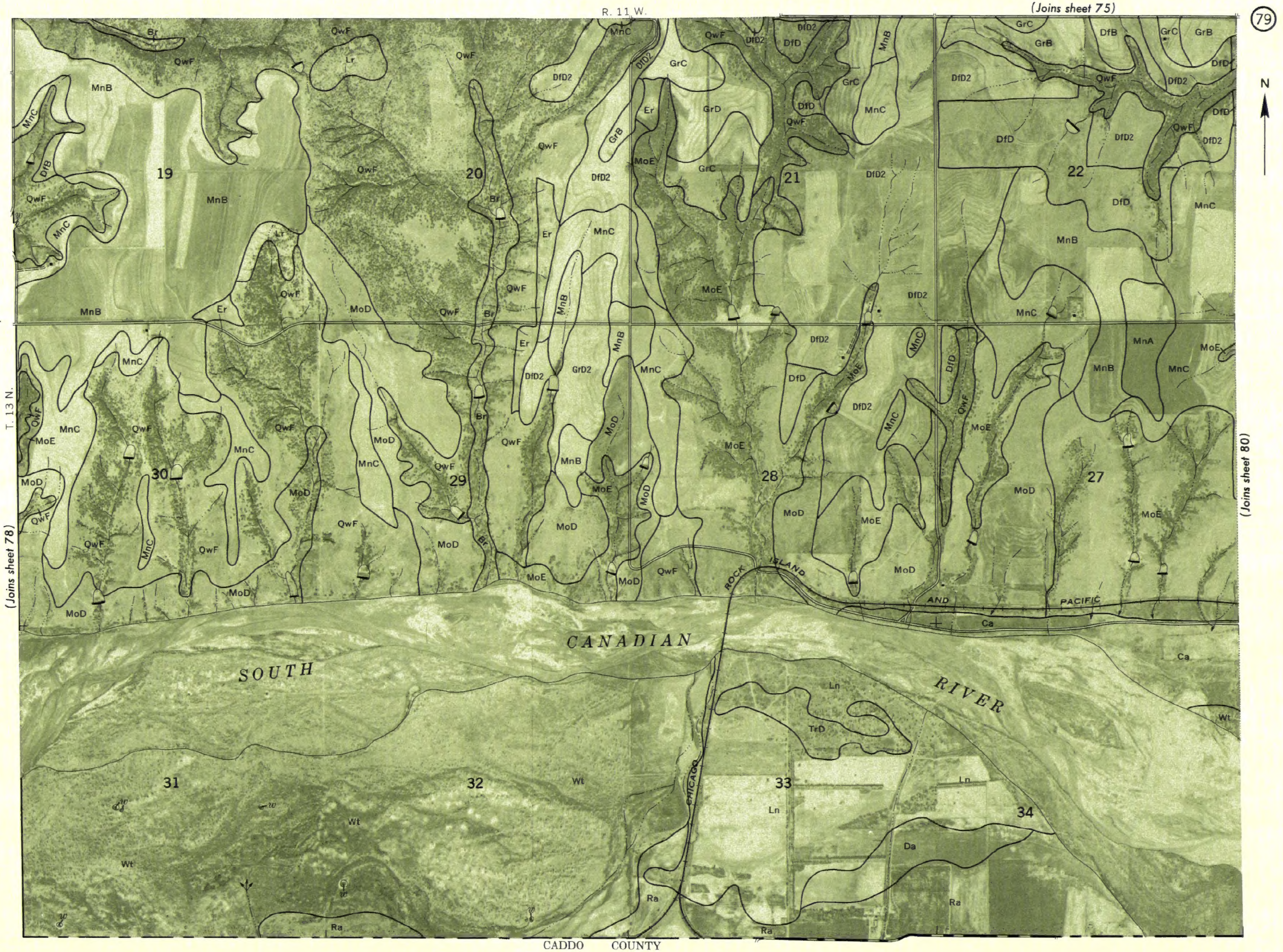
0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

BLAINE COUNTY, OKLAHOMA NO. 77

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

0 ½ 1 Mile Scale 1:20000 0 5000 Feet



CADDO COUNTY

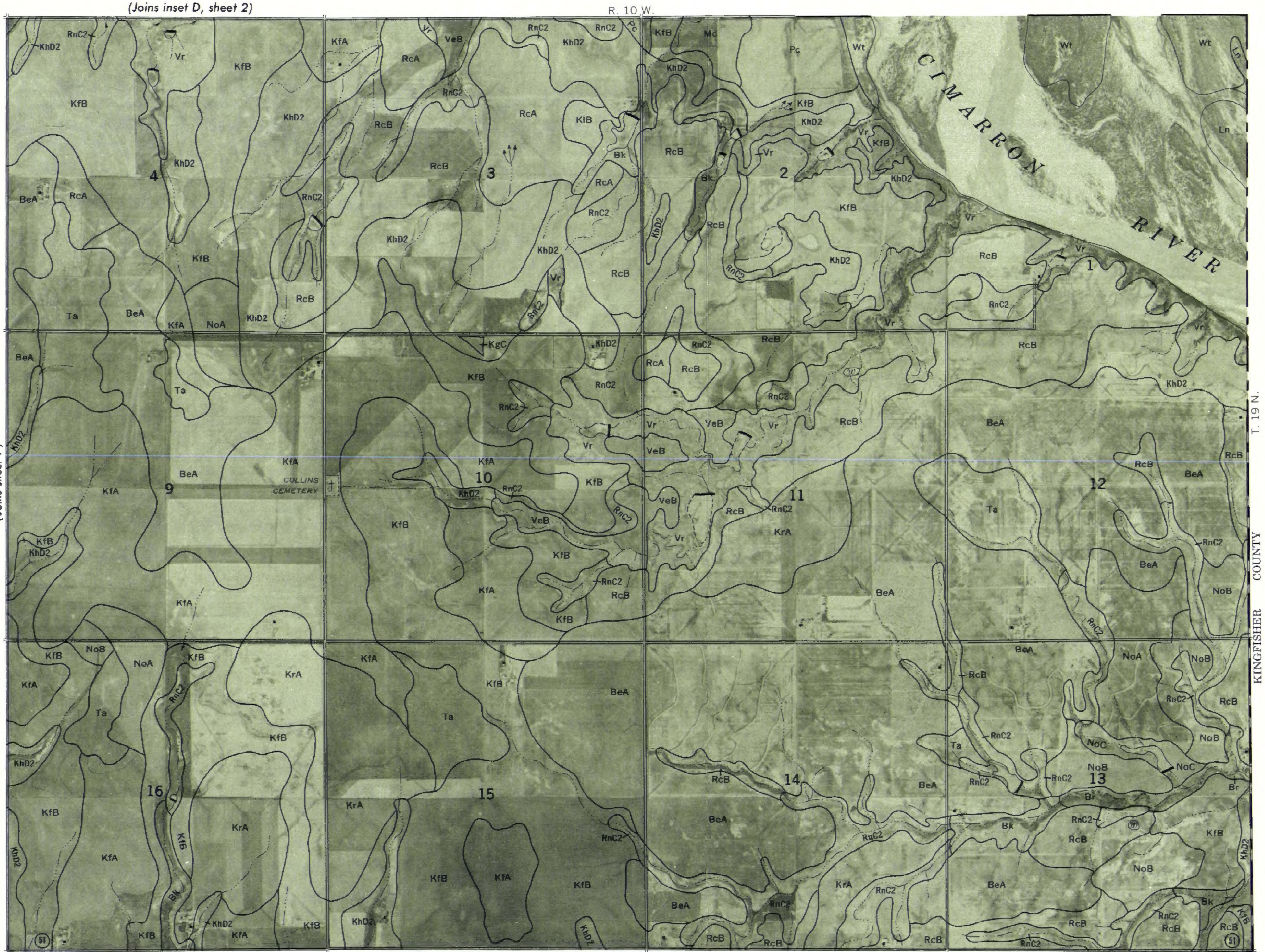
0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Range, township, and section corners shown on this map are indefinite.

8

(Joins inset D, sheet 2)

(Joins sheet 7)



(Joins sheet 14)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

80

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

9

R. 13 W.

(Joins sheet 3)

(Joins sheet 10)

(Joins sheet 15)

0 ½ 1 Mile

Scale 1:20000

0 5000 Feet

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BLAINE COUNTY, OKLAHOMA NO. 9